

University of Nebraska - Lincoln

DigitalCommons@University of Nebraska - Lincoln

Soil Science Research Reports

Agronomy and Horticulture Department

1977

Soil Science Research Report - 1977

Follow this and additional works at: <https://digitalcommons.unl.edu/agronomyssrr>



Part of the [Agronomy and Crop Sciences Commons](#)

"Soil Science Research Report - 1977" (1977). *Soil Science Research Reports*. 7.
<https://digitalcommons.unl.edu/agronomyssrr/7>

This Article is brought to you for free and open access by the Agronomy and Horticulture Department at DigitalCommons@University of Nebraska - Lincoln. It has been accepted for inclusion in Soil Science Research Reports by an authorized administrator of DigitalCommons@University of Nebraska - Lincoln.

SOIL SCIENCE RESEARCH REPORT - 1977



DEPARTMENT OF AGRONOMY
UNIVERSITY OF NEBRASKA-LINCOLN
LINCOLN, NEBRASKA

TABLE OF CONTENTS

<u>Corn Experiments</u>	<u>Section</u>
Nitrogen Rates on Corn.....	1
Nitrogen Rates for Corn Grain in an Eco-fallow Rotation.....	2
Anhydrous Ammonia and N-Serve ^R for Irrigated Corn.....	3
Anhydrous Ammonia and N-Serve ^R Fall Applied.....	4
Evaluation of Cold-Flow TM Method of Applying Anhydrous Ammonia...	5
Influence of Nitrogen Applied at Silking with a Hi-boy on Irrigated Corn.....	6
Effect of Broadcast Phosphorus, Potassium and Zinc for Irri- gated Corn on Sandy Soils.....	7
Lime and Boron for Corn.....	8
Effect of Irrigation Well Capacity and Plant Population on Pro- duction of Irrigated Corn on a Silt Loam Soil.....	9
Influence of Promesol-30 and Limestone on Irrigated Corn.....	10
Influence of Wex on Irrigated Corn Production.....	11
Use of Humate for Corn Production in Nebraska.....	12
Comparison of New and Old Shoes on a Buffalo Slot Planter in Sod.	13
Comparison of New and Old Shoes on a Buffalo Till Planter.....	14
Water Infiltration and Runoff on Crete and Wymore Soils, Under Center Pivot Irrigation.....	15
<u>Wheat Experiments</u>	
Wheat Fertilization Progress Report.....	16
Irrigated Wheat.....	17
Plant Loss of Nitrogen.....	18
<u>Soybean Experiments</u>	
Influence of Applied N and Moisture on Total Nutrient Uptake and on Root Activity of Soybeans as Measured by ³² P.....	19
Utilization of ¹⁵ N Fertilizer by Nodulating and Non-nodulating Soybean Isolines.....	20
<u>Forage Experiments</u>	
Effect of Phosphorus, Potassium and Sulfur on Yield of Irrigated Alfalfa Grown on a Silt Loam Soil..... <i>Rehn</i>	21
Effect of Rate of Boron Applied to Alfalfa grown on an Irrigated Silt Loam..... <i>Rehn</i>	22
Fertilizer Requirements for Pasture Renovation Practices on Silt Loam Soil..... <i>Rehn</i>	23
Fertilizer Requirements for Pasture Renovation Practices on Sandy Soils..... <i>Rehn</i>	24
<u>Foliar Fertilization Experiments</u>	
Foliar Fertilization of Soybeans.....	25
Foliar Fertilization of Field Beans.....	26
Foliar Fertilization of Potatoes and Wheat.....	27
Nitrogen Losses from Sprinkler Applied Nitrogen Fertilizer.....	28
<u>Liming Experiments</u>	
Lime Requirements for Acid Sandy Soils.....	29

<u>Soil Testing Experiments</u>	<u>Section</u>
Optimum Economic Use of Fertilizers Through Effective Soil Testing.....	30
Fertilizer Needs Under Conditions of High P and K Accumulation in Soils.....	31
Northeast Nebraska Soil Productivity Status.....	32
Etc. Etc.	
Pheasant Repellency Experiments.....	33

CONTRIBUTORS TO THE REPORT

Personnel located at Department of Agronomy; University of Nebraska; Keim Hall; East Campus; Lincoln, Nebraska; 68583:

Al-Ithawi, Graduate Research Assistant, Agronomy
Bert R. Bock, Research Assistant, Agronomy
Edward J. Deibert, Research Assistant, Agronomy
August F. Dreier, Professor of Agronomy
Phillip W. Harlan, Assistant Professor of Agronomy
Mark Hooker, Graduate Research Assistant, Agronomy
Robert A. Olson, Professor of Agronomy
Gary A. Peterson, Professor of Agronomy
Donald H. Sander, Professor of Agronomy
Robert C. Sorensen, Professor of Agronomy
Beth Spaugh, Graduate Research Assistant, Agronomy
Richard A. Wiese, Professor of Agronomy

Personnel located at Panhandle Station; 4502 Avenue I; Scottsbluff, Nebraska; 69361:

Frank N. Anderson, Associate Professor of Agronomy
Louis A. Daigger, Professor of Agronomy

Personnel located at North Platte Station; Box 429; North Platte, Nebraska; 69101

Philip H. Grabouski, Assistant Professor of Agronomy
Gary W. Hergert, Assistant Professor of Agronomy

Personnel located at South Central Station; Box 66; Clay Center, Nebraska; 68933.

Kenneth D. Frank, Associate Professor of Agronomy
Leroy L. Peters, Associate Professor of Entomology

Personnel located at Northeast Station; Concord, Nebraska; 68728:

Russell S. Moomaw, Associate Professor of Agronomy
George W. Rehm, Associate Professor of Agronomy

Personnel located at Southeast Extension Headquarters; Miller Hall; East Campus; Lincoln, Nebraska; 68583:

Edwin J. Penas, Associate Professor of Agronomy

NITROGEN RATES ON CORN

Ed Penas, George Rehm, and Dick Wiese

Objective: To determine the relationship between soil test for residual soil nitrate-nitrogen and other soil test characteristics and the amount of nitrogen fertilizer needed to produce a crop of corn.

Procedure: Sites in farmers fields in Northeast, East Central and Southeast Nebraska were selected. Soil samples were collected to a depth of 6 feet. Topsoil samples were analyzed for pH, nitrate-nitrogen, phosphorus, potassium, zinc, and organic matter. Subsoil samples were analyzed for nitrate-nitrogen. Soil test data are shown in the attached tables. Nitrogen as ammonium nitrate was applied prior to or soon after planting of the corn. Rates of nitrogen applied ranged from 0 to 240 or 280 pounds of N per acre in 40-pound increments (0-150 pounds N per acre in 25 lb. increments for non-irrigated sites).

Plant and leaf samples were collected during the growing season, and are being analyzed for nitrogen. Grain yield was determined and yields are reported at 15.5% moisture and shown on the attached tables.

Discussion: These data are a part of a three-year study. Of the 13 sites harvested, only 5 responded to the application of nitrogen. Three of these responsive sites were irrigated sands with approximately 100 pounds of nitrogen in the soil and produced more than 150 bushels of corn per acre. The other two responsive sites were irrigated fine-textured soils. The soil in Saunders County contained 105 pounds of nitrate-nitrogen and yield was increased slightly with nitrogen fertilizer. The site in Polk County had 232 pounds of nitrogen in the soil which produced 169 bushels of corn per acre. The application of nitrogen increased the yield 20 bushels per acre.

This study will be continued. These data should enable soil testing labs to more accurately predict the amount of nitrogen fertilizer needed to achieve a given yield of corn.

NITROGEN RATES ON CORN, 1977
SOIL TEST DATA

<u>Location</u>	<u>Soil pH</u>	<u>Nitrogen, lbs/ac. 6 ft.</u>	<u>Phosphorus, ppm</u>	<u>Potassium, ppm</u>	<u>Zinc ppm</u>	<u>Organic Matter, %</u>
Butler (K)	6.4	114	47 Hi	534 Hi	3.6 Hi	3.0
Gage (B)	5.8	90	4 VLo	125 Hi	3.2 Med	2.4
Polk (W)	5.9	232	80 Hi	598 Hi	5.4 Hi	3.2
Saunders (A)	6.1	105	7 Lo	255 Hi	3.1 Med	2.8
Thurston (1)	7.9	100	4 VLo	219 Hi	---	1.6
Dixon (2)	7.0	278	60 Hi	446 Hi	---	3.5
Dixon (3)	8.0	284	6 Lo	274 Hi	---	1.8
Antelope (4)	6.8	88	24 Med	160 Hi	---	1.8
Antelope (6)	6.4	93	64 Hi	201 Hi	---	1.0
Cuming (7)	6.7	136	22 Med	308 Hi	---	2.3
Cuming (8)	6.1	172	23 Med	400 Hi	---	2.8
Holt (9)	6.6	112	36 Hi	170 Hi	---	1.3
Holt (10)	5.4	200	42 Hi	262 Hi	---	3.6

NITROGEN ON CORN, 1977

<u>Fine textured, irrigated soils</u>				
Location:	<u>Butler (K)</u>	<u>Gage (B)</u>	<u>Polk (W)</u>	<u>Saunders (A)</u>
N, lbs/ac.	<u>Grain Yield, bu/ac.</u>			
0	144	130	169	125
40	148	129	177	130
80	148	132	183	133
120	153	122	187	136
160	148	127	189	138
200	146	134	188	139
240	137	119	186	139
280	150	128	182	139
Response	No	No	Yes	Yes
Nitrogen in Water, and Starter	--	60#	10#	---

<u>Fine textured, non-irrigated soils</u>			
	<u>Thurston (1)</u>	<u>Dixon (2)</u>	<u>Dixon (3)</u>
N, lbs/ac.	<u>Grain Yield, bu/ac.</u>		
0	112	126	121
25	104	128	126
50	111	129	125
75	105	127	133
100	111	132	123
125	114	121	127
150	116	132	135
Response	No	No	No

NITROGEN ON CORN, 1977

<u>Fine textured, irrigated soils</u>		
Location:	<u>Cuming (#7)</u>	<u>Cuming (#8)</u>
N, lbs/ac.	<u>Grain Yield, bu/ac.</u>	
0	119	159
40	122	157
80	127	155
120	120	156
160	128	157
200	124	156
240	122	151
Response	No	No
Nitrogen in Water and Starter	23#	---

<u>Sandy, irrigated soils</u>				
Location:	<u>Antelope (4)</u>	<u>Antelope (6)</u>	<u>Holt (9)</u>	<u>Holt (10)</u>
N, lbs/ac.	<u>Grain Yield, bu/ac.</u>			
0	107	118	165	166
40	132	135	169	177
80	146	149	172	167
120	152	159	175	172
160	153	165	176	168
200	153	167	177	175
240	155	165	177	167
Response	Yes	Yes	Yes	No
Nitrogen in Water and Starter	53#	50#	36#	58#

Project: Nitrogen Rates for Corn Grown in an Ecofallow Rotation

Personnel: Gary W. Hergert, UN-North Platte Station

Goal: Establish relationship between soil tests for residual soil nitrate-nitrogen and N rate needed to produce corn in this farming system.

Procedure: Studies were conducted at three locations. Ammonium nitrate was broadcast immediately after planting on all three locations. Anhydrous ammonia was sidedressed at the UN-Dryland Farm on June 24. Soil analyses and grain yields are given in the following tables.

Schaffert Farm Soil Analysis

pH	O.M.	P	K
		---ppm---	
6.4	1.55%	26	459

Schaffert Ecofallow Corn Yields

NH ₄ NO ₃ -N	Grain Yield
kg/ha	kg/ha
0	3826
28	5143
56	5143
84	5770
112	4641
140	6711

Schroeder Farm Soil Analysis

pH	O.M.	NO ₃ -N	P	K
		#/A-5'	----ppm----	
6.7	1.50%	81	12	397

Schroeder Ecofallow Corn Yields

NH ₄ NO ₃ -N	Grain Yield
kg/ha	kg/ha
0	3575
28	3450
56	4955
84	5958
112	6084
140	6272

UN-Dryland Farm Soil Analysis

pH	O.M.	NO ₃ -N	P	K
		#/A-5'	----ppm----	
6.1	1.70%	97	15	485

Dryland Farm Ecofallow Corn Yields

Nitrogen	NH ₄ NO ₃	NH ₃
	Grain Yield	kg/ha
0	4265	4265
28	4955	4516
56	5143	4767
84	5206	5206
112	5080	5018
140	5457	5206

A nitrogen response was noted at all locations. At North Platte yields were increased by adding up to 84 kg nitrogen per acre. No difference between broadcast NH₄NO₃ and sidedressed NH₃ was shown. At the other two locations yields were maximized with 84-112 lbs nitrogen per acre.

Project: Anhydrous Ammonia and N-Serve^R for Irrigated Corn

Personnel: Gary W. Hergert, UN-North Platte Station

Goal: Evaluate the effects of preplant anhydrous ammonia with or without N-Serve on corn growth, N uptake and grain yield.

Treatments and Design:

The experimental design was a split-split plot. The main plot was watering rate. Irrigation amounts applied were a percentage of actual weekly evapotranspiration (ET) determined by the modified Penman equation. The five water rates in 1977 were: W1: 69% of ET; W2: 78% of ET; W3: 85% of ET; W4: 100% of ET; W5: 119% of ET.

The first split of the plots was the N-Serve variable. The N-Serve rates were 0 lbs or 0.56 kg of N-Serve per hectare in the anhydrous ammonia.

The next split was the nitrogen rate. Rates were 0, 35, 70, 105, 140, 175, and 210 kg/hectare. Anhydrous ammonia was applied May 6-7, 1977. Treatment mean grain yields are shown in Table 1.

Table 1. Grain yields

N-Serve kg/ha	Irrigation as % of ET									
	69%		78%		85%		100%		119%	
	with	w/o	with	w/o	with	w/o	with	w/o	with	w/o
Nitrogen kg/ha	-----kilograms per hectare-----									
0	4604		5065		6450		5657		5340	
35	5898	4941	7006	5996	6799	5663	7624	5506	7053	5981
70	6017	5622	7875	7150	7914	8606	8346	7907	8141	7839
105	6963	6300	8035	7408	9069	8445	8894	9844	8394	10492
140	7958	7122	8568	8218	9411	8259	9606	10042	9841	9349
175	7043	7018	9267	8538	8845	9057	9330	9778	9628	9926
210	7066	6890	8481	7836	9600	9656	9531	9878	10828	10063

The analysis of variance showed a significant effect from water level, nitrogen rate, water rate by N-rate interaction, N-Serve by N rate interaction, and the water rate by N-Serve by N rate interaction at the 1% level. The N-Serve by nitrogen rate interaction resulted from increased yield at the 35 and 70 kg/ha N rates which received the N-Serve. Data in Table 2 show N rates with and without N-Serve averaged over all irrigation levels.

Table 2. Grain yields as affected by
N-rate and N-Serve.

Nitrogen	N-Serve	
	with	w/o
-----kg/ha-----		
0		5423
35	6876	5617
70	7658	7425
105	8271	8498
140	9077	8598
175	8822	8863
210	9101	8864

Preplant applications of anhydrous ammonia produced optimum yields on this sandy soil. Research will continue in 1978.

FALL-APPLIED N-SERVE PLUS ANHYDROUS AMMONIA - SOUTH CENTRAL STATION

Kenneth D. Frank

Experimental Procedure

This experiment was designed to evaluate the effect of N-Serve added to anhydrous ammonia for fall application. Four different rates of anhydrous ammonia were used: 105 pounds, 145 pounds, 185 pounds, and 225 pounds per acre. Each rate was tested with and without one-half pound N-ServeTM per acre. A complete randomized block design with four replications was used.

Anhydrous ammonia and N-Serve were applied on November 8-9, 1976, using a standard anhydrous ammonia applicator. The soil temperature was 56° F at six inches. The test area was planted May 6, 1977, with Golden Harvest hybrid seed corn Variety 2500 with a 28,000 seed drop per acre. Six gallons/A of 10-34-0 + 1% zinc starter fertilizer were applied at planting. The test area was under towline irrigation; however, due to sufficient rainfall during the growing season, it was irrigated only three times.

Results

A severe hailstorm on September 11, 1977, caused considerable damage and undoubtedly contributed to yield variability as shown in Table 2. Consequently, treatments did not significantly influence yield (Table 1).

Table 1. Fall-Applied N-Serve Plus Anhydrous Ammonia

ANALYSIS OF VARIANCE GRAIN YIELD

Source	Degree of Freedom	Sum of Squares	Mean of Squares	F Value
Total	31.0	9,259.88		
Block	3.0	766.13	255.38	.7866
Treatment	7.0	1,676.38	239.48	.7376
Error	21.0	6,817.38	324.64	

Table 2. Fall-Applied N-Serve Plus Anhydrous Ammonia Treatments and Grain Yield

<u>Treatment Number</u>	<u>Treatment</u>
1	105 Lbs N/Acre
2	145 Lbs N/Acre
3	185 Lbs N/Acre
4	225 Lbs N/Acre
5	105 Lbs N + .5 Lbs N-Serve/Acre
6	145 Lbs N + .5 Lbs N-Serve/Acre
7	185 Lbs N + .5 Lbs N-Serve/Acre
8	225 Lbs N + .5 Lbs N-Serve/Acre

Grain Yield (Bu/A)

<u>Treatment</u>	<u>Replication</u>				<u>Total</u>	<u>Mean</u>
	<u>I</u>	<u>II</u>	<u>III</u>	<u>IV</u>		
1	136	170	132	180	618	155
2	137	171	182	168	658	165
3	172	179	166	167	684	171
4	183	165	178	150	676	169
5	153	191	190	167	701	175
6	152	173	148	181	654	164
7	173	136	153	172	634	159
8	164	193	194	154	705	176

Table 3. Mean Nutrient Content of Corn Ear Leaf at 15% Silking as Influenced by N Rate With and Without N-Serve

Treatment	NUTRIENT		
	N%	P%	K%
1	3.12	.317	2.20
2	3.07	.315	2.60
3	3.03	.296	2.51
4	3.14	.308	2.70
5	3.08	.324	2.64
6	3.19	.333	2.28
7	3.22	.308	2.31
8	3.20	.321	2.42

EVALUATION OF COLD-FLOTM METHOD OF APPLYING ANHYDROUS AMMONIA

Kenneth D. Frank

Cold-floTM is a process for applying anhydrous ammonia developed by United States Steel and Pennsylvania State University. In general, the ammonia expands in a chamber such that approximately 85 percent of the anhydrous leaves as liquid and 15 percent as vapor both at approximately minus 28° F and at very low pressure (approximately 2 psi).

In general, soil type, percent soil moisture, and amount of ammonia applied per outlet determine depth the anhydrous should be applied to minimize ammonia loss from the soil after application.

Experimental Procedure

Three experiments were planned to evaluate Cold-floTM. The first one involved a study with irrigated corn on a Hastings silt loam soil that had been fall-chiseled. The treatments were as follows:

1. Cold-floTM mounted on a disk, liquid NH₃ dribbled on the soil surface
2. Cold-floTM and Harlan knives on disk
3. Harlan knives on disk (anhydrous directly from regulator)
[Hot Flow]
4. Anhydrous knifed in with regular applicator on 30-inch centers.

Treatments 1, 2, and 3 had outlets on approximately 16-inch centers. The four methods of application were used to apply N as NH₃ at two rates--90 and 180 pounds per acre.

The Harlan knives are manufactured by Harlan Manufacturing Company, Harlan, Iowa.

The second experiment involved three methods of application:

1. Disk--Harlan knives - Cold-floTM
2. Disk--Harlan knives - Regular or "Hot Flow"
3. Regular application--30-inch spacing

Nitrogen was applied on April 26 at 120 pounds of N per acre. All three methods were on a field previously in sorghum with no prior disking nor stalk shredding.

In order to evaluate the influence of method of application on germination, sorghum was planted on May 12 and 25. There were no observed effects of anhydrous on plant population. The intent was to plant sorghum within three days of anhydrous application; however, wet weather delayed planting date.

The third experiment had the same three methods of application except the field was disked prior to application.

Results

Unfortunately, hail in September completely destroyed the sorghum crop. The hail also damaged the corn grown in Experiment 1. The experiment was harvested; however, grain yield was not influenced by method of application nor nitrogen rate. These experiments will be continued in 1978.

INFLUENCE OF NITROGEN APPLIED AT
SILKING WITH HIBOY ON IRRIGATED CORN

Kenneth D. Frank

Experimental Procedure

This experiment was to measure the effect of liquid nitrogen applied at silking on the yield of irrigated corn. Seven treatments were used: 60, 120, 180 pounds urea applied before planting; 30, 90, 150 pounds urea before planting followed by 30 pounds liquid nitrogen at silking; and a zero nitrogen check. Each treatment was replicated four times using a random block design on a uniform soil.

Urea was spread by hand and disked into soil May 10, 1977, as each treatment detailed. The area was planted May 11, 1977, with Pioneer hybrid seed corn Variety 3390 at a seed drop of 27,000 seeds per acre. Leaf samples were taken July 18, 1977, at 15 percent silk stage before liquid nitrogen application with the hiboy. Leaf samples were taken three more times at two-day intervals following liquid nitrogen application to monitor nitrogen uptake.

The area was under towline irrigation and was watered only three times during growing season due to timely rainfall. On September 11, 1977, a violent hailstorm struck the test area causing 30-40 percent yield loss; therefore, none of the treatments were harvested.

Table 1 shows the leaf analysis at 15 percent silk and for 2, 4, and 6 days after foliar applied N.

TABLE 1. NUTRIENT CONTENT OF EAR LEAF AS INFLUENCED BY FOLIAR APPLIED N.

N Applied at Silking, 1977

<u>Treatment Number</u>	<u>Treatment</u>
1	60 Lbs N/Acre
2	120 Lbs N/Acre
3	180 Lbs N/Acre
4	30 Lbs N/Acre + 30 Lbs N at Silking/Acre
5	90 Lbs N/Acre + 30 Lbs N at Silking/Acre
6	150 Lbs N/Acre + 30 Lbs N at Silking/Acre
7	Zero N Per Acre

MEAN NUTRIENT CONTENT OF CORN EAR LEAF AT SILKING
FOUR LEAF ANALYSES DONE AT 2-DAY INTERVALS
FIRST DONE AT 15% SILKING

Treatment	ANALYSIS I 15% Silk			ANALYSIS II (2 Days After N Applied)		
	N%	P%	K%	N%	P%	K%
1	2.68	.284	2.49	2.01	.341	1.98
2	2.90	.284	2.47	2.17	.352	2.16
3	2.93	.289	2.42	1.96	.321	2.05
4	2.67	.285	2.24	1.88	.384	2.14
5	2.66	.268	2.29	2.00	.416	2.05
6	2.74	.278	2.46	2.09	.363	2.45
7	2.50	.225	2.35	1.81	.297	1.89

ANALYSIS III
(4 Days After N Applied) ANALYSIS IV
(6 Days After N Applied)

Treatment	N%	P%	K%	N%	P%	K%
1	2.68	.347	2.60	2.59	.305	1.75
2	2.90	.340	2.66	2.92	.330	1.84
3	2.86	.344	2.79	2.92	.241	1.95
4	2.45	.367	2.72	2.85	.361	1.79
5	2.70	.346	2.66	2.81	.341	1.61
6	2.91	.370	2.64	2.95	.360	1.94
7	2.45	.300	2.43	2.48	.293	1.90

EFFECT OF BROADCAST P, K, AND ZN FOR IRRIGATED CORN ON SANDY SOILS

G.W. Rehm, R.A. Wiese

Objective:

With the recent developments in center pivot irrigation, many acres in northeast and north central Nebraska have been converted from native range to continuous corn. There is limited information on the rate of P, K, and Zn needed to produce corn on these irrigated sandy soils. In addition, there is very little information on the changes in soil test values for these 3 nutrients as influenced by fertilizer application.

Procedure:

This study was initiated in Pierce County in 1974. The site selected had been in native range and was planted to corn in 1974. The soil is classified as a Thurman loamy fine sand. Five rates of P, K, and Zn from a 5³ complete factorial were selected to fit a central composite factorial design and replicated 3 times. The P (0, 10, 20, 30, 40 lb./acre) was supplied as 0-46-0, the K (0, 30, 60, 90, 120 lb./acre) as 0-0-60, and Zn (0, 3, 6, 9, 12 lb./acre) as ZnSO₄. Sulfur, as granular gypsum, was applied to all plots at a rate of 30 lb. S/acre. Adequate N was applied to all plots and recommended herbicides and insecticides were used at planting.

Fertilizer materials were broadcast and incorporated each year. Treatments were repeated in 1975, 1976, and 1977. Both forage and grain yields were recorded each year. Soil samples (0-8 in.) were collected each fall.

Results and Conclusions:

In the interest of brevity, grain yields only will be included in this report. Throughout the study, there has been no significant response to the application of K and Zn. The application of fertilizer P has increased yields (Table 1). The response to applied P was linear in 1974, the initial year of the study. Thereafter, the response was curvilinear with the repeated use of 46 lb. P₂O₅/acre producing maximum yield.

The levels of P, K, and Zn in the surface soil changed with the repeated application of fertilizers. The increase of the P level has been linear with applied P. The initial P content was 6 ppm. It should be noted that soil test levels for P increased with the repeated use of 46 lb. P₂O₅/acre.

Each year the K content increased linearly with applied K (Table 3). The same trend was followed for the Zn content of the soil (Table 4).

Table 1. Effect of rate of applied P_2O_5 on yield of corn grain on an irrigated sandy soil.

P_2O_5 Applied lb./acre	Year			
	1974	1975	1976	1977
	----- bu./acre -----			
0	104.9	150.4	131.8	122.2
23	116.6	172.3	149.6	150.4
46	124.3	183.4	159.2	167.3
69	128.1	183.9	160.5	173.2
92	127.9	173.6	153.9	167.8

Table 2. Effect of rate of applied P_2O_5 on the P content of an irrigated sandy soil as measured by the Bray #1 procedure.

P_2O_5 Applied lb./acre	Year			
	1974	1975	1976	1977
	----- ppm P -----			
0	6.6	7.5	4.1	4.6
23	8.0	7.8	8.1	6.5
46	9.3	10.6	12.1	10.2
69	10.3	16.0	17.3	15.8
92	11.2	23.9	22.5	23.2

Table 3. Effect of rate of applied K_2O on the K content of an irrigated sandy soil.

K_2O Applied lb./acre	Year			
	1974	1975	1976	1977
	----- ppm K -----			
0	71.5	103.1	58.3	67.3
36	77.6	116.6	69.4	80.5
72	83.1	127.7	80.8	94.1
108	88.0	136.5	92.5	108.1
144	92.2	143.0	104.4	122.5

Table 4. Effect of rate of applied Zn on the Zn content of an irrigated sandy soil.

Zn Applied lb./acre	Year			
	1974	1975	1976	1977
	----- ppm Zn -----			
0	1.8	2.2	3.0	2.6
3	2.5	4.3	5.1	4.2
6	3.1	6.0	7.6	6.0
9	3.7	7.2	10.3	8.2
12	4.2	8.1	13.4	10.7

Lime And Boron For Corn

G.W. Rehm and R.A. Wiese

Objective:

In general, the pH of the surface 0-8 in. of sandy soils in north-central Nebraska has decreased with production of continuous corn under sprinkler irrigation systems. The decrease in soil pH raises questions as to the need for lime for corn production on these irrigated sandy soils. In addition, there is very little information on the requirement for boron for corn production on these soils. Therefore, this study was designed to evaluate the effect of application of lime and boron for corn production on irrigated sandy soils.

Procedure:

This study was initiated in 1975 at sites in Pierce and Holt Counties. Boron was broadcast in early spring at both sites to supply 0, .75, 1.50 and 3.00 lb. B/acre. Lime rates at the Pierce County site were 0, 1.7, and 3.4 ton/acre. The lime rates used at the Holt County site were 0, 2.25 and 4.50 ton/acre. Residual effects of the 1975 treatments were measured in 1976. The boron was reapplied to the Holt County site in early spring of 1977. Residual effects of lime applied to this site in 1975 were measured in 1977. The study at the Pierce County site was discontinued at the close of the 1976 growing season. Adequate rates of all other nutrients were supplied in all years at both sites.

In addition to yield, soil samples (0-8 in.) were collected periodically to monitor changes in soil pH as well as the level of B, Zn, Mn, Fe, and Cu in the surface soil. This study will be continued in 1978.

Results and Conclusions:

In the interest of brevity, results from the Holt County site will be presented in this report. Soil properties at the initiation of the study are listed in Table 1.

Application of boron had no effect on yield in 1975 and 1977. The use of this nutrient decreased corn yields in 1976 (Table 2). At present, there is no explanation for this reduction. Corn yields in both 1975 and 1976 were increased by the application of lime. The response to lime was linear in 1975 (Table 3). In 1976, the first increment applied in 1975 increased yields but there was no yield increase from the 4.50 ton/acre rate. Yields recorded in 1977 were not significantly affected by the rate of lime applied in 1975. Although lime has increased corn yields at this site, with current market prices for corn, the yield increase has not been large enough to offset the cost of the lime.

The pH of the surface soil has increased with the application of lime (Table 4). When no lime was applied, there was a slight increase in pH through the summer of 1975. It's important to point out that the pH of the surface soil has not dropped below the initial pH after 3 growing seasons. With the application of 2.25 ton of lime per acre in 1975, the pH rose to 6.0 and has gradually decreased to 5.7 after 3 growing seasons. The 2.25 ton/acre is .75 " of the lime requirement for this soil. Soil pH continues to increase with the 4.50 ton/acre applied in 1975. The 4.50 ton/acre is 1.5 times the lime require-

ment of this soil.

At the present time, data indicate that application of boron has no beneficial effect on yield. Yields will be recorded in 1978 to further evaluate the effect of the lime applied in 1975.

Table 1. Properties of the soil at the experimental site (Holt County) at initiation of the study in 1975.

Soil Type	O'Neill sandy loam
pH	5.2
pH (Buffer)	6.4
Potassium, ppm	212
Phosphorus (Bray), ppm	19
Organic Matter Content, %	2.21
Cation Exchange Capacity me/100gm	7.31
Hot Water Soluble Boron, ppm	11.2

Table 2. Effect of the application of boron on the yield of irrigated corn.

Boron Applied lb./acre	Year		
	1975	1976	1977
	----- bu./acre -----		
0	190.1 a	199.9 b	188.8 a
.75	189.4 a	189.7 a	186.9 a
1.50	184.6 a	193.4 a	185.8 a
3.00	189.1 a	191.8 a	189.6 a

Table 3. Yield of irrigated corn as influenced by lime applied in early spring of 1975.

Lime Applied ton/acre	Year		
	1975	1976	1977
	----- bu./acre -----		
0	184.0 a	189.2 a	185.9 a
2.25	188.2 b	196.2 b	186.8 a
4.50	192.7 c	195.8 b	190.6 a

Table 4. Soil pH (0-8 in.) as influenced by the rate of lime applied in early spring of 1975.

Lime Applied ton/acre	Sampling Date				
	6/75	7/75	11/75	4/76	10/77
	----- pH -----				
0	5.3 a	5.5 a	5.4 a	5.2 a	5.2 a
2.25	5.8 b	5.8 b	6.1 b	6.2 b	5.7 b
4.50	6.1 c	6.2 c	6.3 c	6.4 b	6.5 c

EFFECT OF IRRIGATION WELL CAPACITY AND PLANT POPULATIONS ON PRODUCTION OF
IRRIGATED CORN ON A SILT LOAM SOIL

G. W. Rehm

Objective:

Pumping capacities of irrigation wells in northeast Nebraska vary over a wide range. The capacity of some wells is marginal. With a limited supply of irrigation water in some years, the plant population used for corn production may have to be adjusted to take into consideration the capacity of the irrigation well. This study, designed to be conducted on a long term basis, was established to measure the effect of plant populations and capacity of the irrigation well on the yield of irrigated corn grown on a silt loam soil.

Procedure:

The soil at the experimental site at the Northeast Experiment Station is classified as a Judson silt loam. Soil properties are listed in Table 1. Corn was planted with a tillplanter on May 17. Recommended herbicides and insecticides were used. Evapotranspiration was computed from weather data collected at the Northeast Experiment Station. The six planted plant populations and 3 well capacities used are listed in Table 2 and 3. All treatments received 180 lb. N/acre as 28-0-0 as a sidedress application. A total of 5 in. of irrigation water was applied during the growing season. Grain yields and plant populations were recorded at harvest in early November.

Table 1. Properties of the Judson silt loam at the experimental site. 1977.

pH	6.3
Buffer pH	7.0
Available P (Bray), ppm	30
Exchangeable K, ppm	331
NO ₃ -N to 6 ft., lb./acre	68
Organic Matter Content, %	2.9

Results and Conclusions:

The precipitation pattern for the 1977 growing season at the Northeast Experiment Station was nearly ideal. Therefore the application of 5 in. of irrigation water was easily accomplished with the simulated 400 gpm well capacity and the simulated well capacities had no effect on yield (Table 2).

Plant populations recorded at harvest were much lower than anticipated (Table 3) and steps will be taken to correct this problem in future years. Plant population had a highly significant effect on yield with the response being curvilinear for 1977. There was no interaction between plant population and well capacity. Since this study will be conducted on a long term basis, it is inappropriate to draw conclusions at this time.

Table 2. Effect of simulated well capacity on yield of irrigated corn on a silt loam soil.

Well Capacity (gpm)	Yield (bu. #2 corn/acre)
400	170.5
600	169.9
800	169.4

Table 3. Effect of plant population of the yield of irrigated corn grown on a silt loam soil. 1977.

Planted Population	Population at Harvest	Yield
----- plants/acre -----	-----	bu. #2 corn/acre
18,300	13,939	146.2
21,200	16,117	161.6
23,900	17,860	172.1
26,500	20,038	178.6
29,300	21,780	181.6
31,100	23,958	179.3

THE INFLUENCE OF PROMESOL-30 AND LIMESTONE ON IRRIGATED CORN

Ed Wiedel Farm
Deshler, Nebraska
(1976 and 1977)

Promesol-30 was obtained from Carpenter Sales, Inc., Bondurant, Iowa. Promesol-30 is claimed to influence the pH of acid soils. On a volume basis, Promesol-30 liquid has the following analysis:

Trihydroxy - Glutaric Acid	54%
Elemental - Calcium	25%
Elemental - Nitrogen	5%
pH	3.7%
Specific Gravity	1.36 g/cc

Experimental Procedure

Previous experiments with irrigated corn in Nebraska indicated response to lime could be expected if the pH of the soil was below 6.0. In order to evaluate the effectiveness of Promesol-30 on improving grain yield on acid soil, an experiment involving Promesol-30 and limestone was established on Mr. Ed Wiedel's farm near Deshler, Nebraska, in the spring of 1976. The treatments were as follows:

1. Zero lime
2. 4 ton CaCO_3
3. 8 gallon Promesol-30 in 1976 + 12 gallon Promesol-30 in 1977
4. 4 gallon Promesol-30 in 1976, + 12 gallon Promesol-30 in 1977, + 4 gallon Promesol-30 in 1978

The material was initially applied on April 6, 1976, and disked in. Mr. Wiedel then treated the plot area as part of his field. In 1977, treatments 3 and 4 were applied on April 11.

Results

Table 1 shows the grain yield for 1976 and 1977. There was no significant effect of Promesol-30 on yield either year. The 1976 price of Promesol-30 was \$2.50 per gallon. Lime significantly increased yield in 1976, but there were no significant differences in 1977. Table 2 shows the influence of Promesol-30 and applied limestone on pH. Samples were obtained in April of 1977. As shown in Table 2, pH was increased by the limestone but was not influenced by Promesol-30. This experiment will be continued in 1978.

Table 1. Yield of Irrigated Corn as Influenced by Lime and Promesol-30
Crete sil. Ed Wiedel Farm, Deshler, Nebraska, 1976-1977.

Treatment	Mean No. 2 Corn Bu/A		
	1976	1977	Two Yr
Check	156	164	320
4 Ton Lime ^{1/}	167	164	331
8 Gal/A Promesol-30, 1976 12 Gal/A Promesol-30, 1977 ^{2/}	162	159	321
4 Gal/A Promesol-30, 1976 12 Gal/A Promesol-30, 1977	156	160	316

^{1/} Equivalent to 5,000 pounds 100% CaCO₃

^{2/} Recommended rate Promesol-30 is 4 gallon per 1,000 pounds CaCO₃.
Treatment 4 will receive 4 Gal/A in 1978

Table 2. Influence of Promesol-30 and Limestone on pH of Crete Sil Soil One Year After Application

Treatment	pH Replication			
	I	II	III	IV
Check	5.3	5.4	5.3	5.3
4 Ton Lime	5.8	6.1	5.8	5.8
8 Gallon Promesol-30, 1976 12 Gallon Promesol-30, 1977	5.2	5.4	5.3	5.2
4 Gallon Promesol-30, 1976 12 Gallon Promesol-30, 1977	5.3	5.2	5.5	5.4

THE INFLUENCE OF WEX ON IRRIGATED CORN PRODUCTION

Kenneth D. Frank

Experimental Procedure

The product Wex was tested on a uniform Hastings silt loam soil at the South Central Station farm in Clay County Nebraska in 1976 and 1977. Three different amounts of Wex were applied: 8, 16, and 32 ounces per acre in 1976, and 0, 8, 16, and 32 ounces Wex/A in 1977 along with check plots which received no Wex. All treatments were applied with 220 pounds N/A as sidedress on June 2, 1976, and June 7, 1977. The treatments were randomized across the test area with five replications of each treatment in 1976 and four replications in 1977.

The test area was planted May 7, 1976, to NK74 hybrid seed corn with a Buffalo till planter at an approximate seed drop of 28,500 seeds per acre in 30-inch rows. The 1977 crop was planted on May 12 to Pioneer 3541 hybrid seed corn with a Buffalo till planter at an approximate seed drop of 28,500 seeds per acre in 30-inch rows.

These trials were supported in part by a grant from "The Conklin Company."

Results

Tables 1 through 4 show the results obtained for the two years of this study. Under the conditions of these experiments, Wex had no significant influence on grain yield nor N, P, K content of ear leaf.

Table 1. Analysis of Variance for Rates of Wex Applied with Anhydrous Ammonia on Irrigated Corn, 1976.

Source	Degrees of Freedom	Mean Square	F
Total	19		
Reps	4	90.6	1.48
Treatments	3	22.7	0.37
Error	12	60.85	

Table 2. Influence of Rates of Wex Added to Anhydrous Ammonia on Irrigated Corn Grain Yield and Nutrient Content of the Ear Leaf at Silking. University of Nebraska South Central Station, 1976.

Treatment		Grain Yield No. 2 Corn ^{1/} Bu/A	Mean Nutrient Content of Ear Leaf at Silking in %		
Oz Wex/A	Lbs N/A		N	P	K
0	220	157	2.86	.255	2.85
8	220	160	2.76	.260	2.94
16	220	159	2.78	.255	2.79
32	220	162	2.62	.266	2.87

^{1/} Mean from 5 reps, each 3 rows, 1,200 feet long, machine harvest.

Table 3. Analysis of Variance for Rates of Wex Applied with Anhydrous Ammonia on Irrigated Corn, 1977.

Source	Degrees of Freedom	Mean Square	F
Total	15		
Reps	3	28.2	1.2
Treatments	3	37.1	1.6
Error	9	23.0	

Table 4. Influence of Rates of Wex Added to Anhydrous Ammonia on Irrigated Corn Grain Yield and Nutrient Content of the Ear Leaf at Silking. University of Nebraska South Central Station, 1977.

Treatment		Grain Yield ¹ Bu/A	% Nutrient Ear Leaf		
Oz Wex/A	Lbs N/A		N	P	K
0	220	133	2.91	.29	2.2
8	220	134	3.01	.30	2.3
16	220	130	2.96	.29	2.1
24	220	127	2.92	.30	1.9

^{1/} Mean from 4 reps, each 3 rows, 660 feet long, machine harvest.

THE USE OF THE PRODUCT HUMATE FOR CORN PRODUCTION IN NEBRASKA

Kenneth D. Frank & Frank N. Anderson

Experimental Procedure

Humate was applied in two different areas of the South Central Station farm in Clay County in 1977. Three different rates of humate were tested: 0, 250 lbs/A, and 500 lbs/A. One area was of good uniform soil with treatments in a randomized block with each treatment repeated four times. The other test plot was on a cut area with poor soil although soil was fairly uniform. This area had each treatment repeated five times. In both plots, humate was broadcast on surface by hand and disked into soil before corn was planted.

Both areas received 225 pounds anhydrous ammonia before planting time. The test plot of good soil was planted May 10, 1977, with Pioneer seed corn Variety 3390. The test plot in the cut area was replanted due to poor stand May 26, 1977, using Pioneer seed corn Variety 3541. Both areas had 28,000 seed drop per acre. Each test area was gravity irrigated only twice during the summer due to sufficient rains during the growing season.

The corn matured well before frost date and was picked by hand as both areas were severely hailed September 11, 1977. Approximately 30 percent damage occurred. Corn moisture averaged 18-20 percent at harvest.

Results

There were no significant differences in grain yield due to treatments (Tables 1 and 2), nor did the humate influence nutrient content of ear leaf (Table 3).

TABLE 1. INFLUENCE OF RICH HUMATE ON GRAIN YIELD OF IRRIGATED CORN GROWN ON A CUT AREA. UNIVERSITY OF NEBRASKA SOUTH CENTRAL STATION, 1977.

<u>Treatment Number</u>	<u>Treatment</u>
1	Zero Humate
2	250 Lbs Humate/Acre
3	500 Lbs Humate/Acre

Grain Yield (Bu/A) Cut Area
(Replication)

Treatment	I	II	III	IV	V	Total	Mean
1	90	78	104	81	102	455	91
2	110	90	95	66	93	454	91
3	108	73	90	101	83	455	91

Analysis of Variance (Cut Area)

Source	Degrees of Freedom	Sums of Squares	Mean of Squares	F Values
Total	14	2344.93		
Block	4	1051.60	262.90	1.62
Treatment	2	0.13	0.06	0.00
Error	8	1293.20	161.65	

TABLE 2. INFLUENCE OF RICH HUMATE ON IRRIGATED CORN YIELD ON SOIL WITH TOPSOIL NOT REMOVED. UNIVERSITY OF NEBRASKA SOUTH CENTRAL STATION, 1977.

<u>Treatment Number</u>	<u>Treatment</u>
1	Zero Humate
2	250 Lbs Humate/Acre
3	500 Lbs Humate/Acre

Grain Yield (Bu/A) Good Soil Area

Treatment	I	II	III	IV	Total	Mean
1	142	144	161	160	607	152
2	156	149	154	140	599	150
3	156	148	157	154	615	154

Analysis of Variance (Good Soil Area)

Source	Degrees of Freedom	Sum of Squares	Mean of Squares	F Values
Total	11.0	542.25		
Block	3.0	162.25	54.08	0.93
Treatment	2.0	32.0	16.00	0.27
Error	6.0	348.0	58.00	

TABLE 3. INFLUENCE OF RICH HUMATE ON NUTRIENT CONTENT OF EAR LEAF AT SILKING.
UNIVERSITY OF NEBRASKA SOUTH CENTRAL STATION, 1977.

Mean Nutrient Content of Corn Ear Leaf at Silking

(Good Soil Area)

Treatment	NUTRIENT		
	N%	P%	K%
1	2.89	.241	2.15
2	2.70	.292	2.48
3	2.62	.276	2.45

Acknowledgment

This study was funded in part by a grant from Wass-Lo Enterprises, Inc., Grant, Nebraska. Evaluation of the product will continue in 1978 in cooperation with Frank Anderson, Panhandle Station.

COMPARISON OF NEW AND OLD SHOES
ON BUFFALO SLOT PLANTER IN SOD

Kenneth D. Frank

Experimental Procedure

Two types of slot shoes were tested--the original Buffalo slot shoe and the new redesigned slot shoe which is considerably narrower than the original. To insure even seed drop, two old shoes were mounted on the left side of the planter and the two new shoes on the right. Three sod strips were planted consisting of 16 rows each.

Broadcast urea at the rate of 300 pounds per acre was applied prior to planting. The sod was planted May 19, 1977, with Pioneer hybrid seed corn Variety 3382 at a seed drop of 30,500 seeds per acre. Also, eight gallon per acre of 10-34-0 + 1% Zn starter fertilizer was applied with the seed at planting. Furadan was applied at 12 oz/1,000 feet of row. Atrazine at 3 lbs/A was applied in a 14-inch band over the row.

The sod strips were under towline irrigation; however, due to sufficient rainfall, the sod was irrigated only three times during the growing season. On September 11, 1977, a severe hailstorm struck the test area, causing approximately 30 percent yield loss. The corn matured before frost date and was harvested by machine with grain moisture between 19-23 percent.

Fleischer Manufacturing Company, Columbus, Nebraska, supported this work.

Results

Table 1 shows grain yield for the two types of shoes. Under the conditions of this experiment, yield from the new type shoe was significantly better than the old type.

Table 1. Irrigated Corn Yield as Influenced by New and Old Style Shoes on Buffalo Slot Planter in Sod. University of Nebraska South Central Station, Clay Center, Nebraska.

Plot	Shoe Type	(Bu/A) Grain Yield	Plot	Shoe Type	(Bu/A) Grain Yield
101	Old	95	102	New	102
104	Old	104	103	New	125
105	Old	80	106	New	136
108	Old	97	107	New	136
202	Old	95	201	New	140
203	Old	---			
205	Old	90	206	New	116
207	Old	110	208	New	128
302	Old	92	301	New	117
303	Old	83	304	New	92
306	Old	86	305	New	88
307	Old	94	308	New	102
	Total	1,026		Total	1,282
	Mean	93		Mean	117

T STATISTIC

$$\bar{X} = 93.2727 \quad S_y = 18.3049$$

$$\bar{Y} = 116.5454 \quad v = 20.0$$

$$S_x = 8.7303 \quad t = 3.8060 \text{ sig} > .01$$

COMPARISON OF OLD AND NEW SLOT SHOES ON BUFFALO TILL PLANTER

Kenneth D. Frank

Experimental Procedure

Two types of slot shoes were compared in this experiment. The original Buffalo slot shoe and the new redesigned slot shoe. For comparison, two new and two old slot shoes were used on a four-row Buffalo till planter. A uniform plot of soil was planted after old stalks were shredded. The plot consisted of 20 rows, 630 feet long.

Pioneer hybrid seed corn Variety 3541 was planted May 20, 1977, with seed drop of 30,500 seeds per acre. The plot received 225 pounds N/A preplant application and received 8 gallons/A of 10-34-0 + 1% starter fertilizer at planting. The plot was under solid set irrigation; however, due to sufficient rainfall, the test was irrigated only four times during the growing season.

The test area suffered some minor hail damage three weeks after planting and major hail damage September 11, 1977, when 30 percent yield loss occurred. The corn matured well before frost date and was harvested by machine on October 27, 1977.

Results

As shown in Table 1, there was a seven bushel yield increase from the new slot shoe. However, due to variability, the significance level is between .25 and .10.

Table 1. Corn Yield as Influenced by Old and New Shoes on Buffalo Till Planter.

Plot	Shoe Type	(Bu/A) Yield	Plot	Shoe Type	(Bu/A) Yield
101	Old	115	102	New	115
202	Old	126	201	New	123
301	Old	124	302	New	129
402	Old	114	401	New	136
501	Old	120	502	New	130
	Total	599		Total	633
	Mean	120		Mean	127

ANALYSIS OF VARIANCE

Source	Degrees of Freedom	Sum of Squares	Mean of Squares	F Value
Total	9.0	481.60		
Block	4.0	172.60	43.15	0.89
Treatment	1.0	115.60	115.60	2.39
Error	4.0	193.40	48.35	

Acknowledgment

This study was supported in part by Fleischer Manufacturing Company, Columbus, Nebraska.

TITLE: Water Infiltration and Runoff on Crete and Wymore Soils,
Under Center Pivot Irrigation.

PERSONNEL: Hanna, Harlan, Lewis, Soil Conservation Service

OBJECTIVES: To determine if application of water through a center pivot system produced runoff and increased soil loss. Soil water balance was also used to determine how much the soil took in and how much the corn used.

PROCEDURE: A Crete sicl, and two Wymore sicl soils on 2,4, and 8 percent respectively were selected between the outer towers for locations of small runoff plots and tensiometer placements. Rainfall irrigation soil moisture and runoff were monitored throughout the 1977 growing season.

Seven irrigations applying 14 cm water at a rate of 2 cm/hr resulted in zero runoff and soil loss. The limited irrigation in quantity and intensity, the dry surface and the 900H/Ac residue remaining were deemed the most important factors in eliminating runoff and soil loss by water applied by irrigation. Secondly it was noted that when a rain followed an irrigation there was runoff whereas a similar rain did not cause runoff when it did not follow an irrigation. The wet soil surface was the contributing factor.

The research also substantiated some slope runoff - soil loss relationships. Results showed that runoff and soil loss both increased with slope under natural rainfall but that runoff increased most rapidly when the slope increased from 2 to 4% whereas soil loss had its increase when slope increased from 4 to 8%.

The water balance for the three soils indicated that all site ended the growing season with small losses compared to initial moisture contents. After subtracting for runoff it was found that the Crete site had the largest loss of water for which an accounting could not be made. It was suggested that the loss might be due to deep drainage or higher than normal evaporation at this site.

WHEAT FERTILIZATION PROGRESS REPORT 1977

G. Peterson, D. Sander, L. Daigger and G. Hergert

This report contains a data summary and a brief statement for each of the soil fertility experiments conducted with winter wheat in 1977. The following experiments are included: (1) Comparisons of N-28 solution, anhydrous ammonia, urea and ammonium nitrate as N carriers for wheat grown in eco-fallow systems. (2) Phosphorus fertilizer experiments comparing row and broadcast methods of application. (3) Soil test P levels in Rosebud-Canyon soils several years after application. (4) Residual $\text{NO}_3\text{-N}$ levels in a soil as affected by N carrier, rate and time of application.

1. Nitrogen Carrier Experiments in Eco-fallow Systems

The objective of these experiments was to determine the relative effectiveness of N-28 solution, anhydrous ammonia, urea and ammonium nitrate as N carriers for wheat grown in eco-fallow systems. Two experiments were conducted. One of these was located in Cheyenne County under the two year wheat-fallow system. The second was located in Lincoln County under the three year wheat-sorghum-fallow system. All carriers were compared at five rates of application (0, 20, 40, 60 and 80 lbs N/A) and all were applied both in spring and fall.

The experiment in Cheyenne County winter killed and no harvest was realized. Data from the Lincoln County experiment are summarized in Tables 1 and 2. Note first that the grain yield was 75 bu/A even when no N was applied. This was related to the large amount of carryover N from previous fertilization. Despite the high N carryover there were some positive responses to N fertilization with certain of the carriers when they were applied in the fall. Ammonium nitrate produced a yield increase of 10 bu/A at the 60#/A rate fall applied. Urea tended

to increase yields also but was significantly poorer than ammonium nitrate. N-28 solution fall applied had no effect on grain yield. Anhydrous ammonia had a small negative effect on yield compared to the control.

Spring applied treatments produced no positive yield changes. In fact, both anhydrous ammonia and N-28 solution reduced yields compared to the control treatment. The reduction with anhydrous was directly related to the stand loss associated with knifing NH_3 into the soil. The reason for the decrease due to the application of N-28 solution at rates greater than 4#/A was not obvious.

Straw yields did not respond in the same pattern as did grain yields. All fall applied treatments increased straw yields except the highest rate of anhydrous ammonia. However, ammonium nitrate produced more straw than any other carrier. Spring applied treatments increased straw yields except for the anhydrous ammonia carrier, but increases in straw yield were smaller with spring application than with fall.

Nitrogen uptake responses to the various treatments were as expected and very similar to grain and straw yield responses. Ammonium nitrate which produced both the highest grain and straw yields had the highest N uptake. Likewise, anhydrous ammonia which adversely affected stands with spring application resulted in lowest uptake values.

All materials and all rates of N increased grain protein levels at both application times.

In conclusion it can be stated that carriers did behave differently in terms of grain and straw yield responses. The fall applied anhydrous ammonia was surprisingly inferior to the other carriers. Most likely the short time between application of NH_3 and wheat seeding (one day in this experiment) was the reason for the poor results from the anhydrous. Ammonium nitrate appears to be the standard to which to compare other materials. Although it did produce a

large amount of extra straw compared to the others it also produced the largest grain yield response.

2. Phosphorus Fertilizer Placement Experiments

The objective of these experiments was to compare the relative effectiveness of row placed P fertilizer to that of broadcast P fertilizer on soils with a wide range in pH. Data from six of these experiments conducted in SW Nebraska can be found in Table 3. Experimental locations in this group ranged in pH from 5.8 to 7.6 and from 6 to 30 ppm Bray No. 1 extractable P. Unfortunately, a technical error at planting time caused the row applied treatments to be superimposed on the broadcast treatments. Thus no comparisons of the two methods were possible and the rates of application were double those originally intended. Significant grain yield responses occurred at all sites except the Carter location which had a soil test of 30 ppm. The data verify that our present soil test recommendation categories are valid. However, an interesting point concerning amount of P recommended is raised when the Kasson & Scharf locations are compared to the Gardner #2 location. The three sites test essentially equal in Bray No. 1 P. However, on the two locations with a pH of 6.3 or less the first increment of P maximized the yield, while on the soil with a pH of 7.6, response seemed to continue up to at least the 60# P/A level. These findings most likely are related to the free CaCO_3 content of the higher pH soil. It also points out the reason why we suspect that the relative effectiveness of row applied compared to broadcast P may differ as soil pH varies.

Table 4 contains the data obtained from a similar set of experiments conducted in the Panhandle on soils ranging in pH from 8.0 to 8.2. Appropriate row and broadcast treatments were applied in these experiments. Variability due to drouthiness prevented a good assessment of relative differences between row and broadcast treatments at the Hagstrom and Sato locations. At the Lerwick

location there was a significant response to applied P and a generally equal response to both methods of application.

3. Soil Test P Levels in Rosebud-Canyon Soils Several Years After Application

Rosebud-Canyon soils are formed in sandy limestone resulting in surface soils that range from slightly to highly calcareous. These soils cover over 50 percent of the land surface in some counties in western Nebraska.

These soils are generally deficient in P according to soil tests. It was hypothesized that, because of their calcareous nature, very high rates of fertilizer P may be required. In addition, a limited number of experiments have shown that low P rates are not very effective.

In order to further study the problem of limited yield responses to applied N, nine experiments were established in the fall of 1972 and ten in the fall of 1973 in Cheyenne County. These experiments had four P rates (25, 50, 100, 500 lbs P/A) and five N rates (0, 30, 60, 90, 120 lbs N/A) in a split plot arrangement of treatments. The P was broadcast in August of the establishment year and incorporated with farmer tillage prior to seeding. Yields ^{1/} and plant samples were collected the first two crop years after establishment. The soils were sampled in the spring of 1974, 1975, 1976 and 1977.

Tables 5 and 6 contain the soil test results for both the Bray and Kurtz No. 1 and NaHCO₃ P extractants. On those experiments established in 1972 (Table 5) the 1977 soil test P levels with both tests were at about the same point as in 1976. The Riecken location was the only exception to this. At this point in time it would appear that the P soil test levels in these soils can be raised to sufficiency levels and maintained there without continuous P applications.

Data from the experiments established in 1973 (Table 6) are about in the

^{1/} For yield information see Soil Science Progress Report-1976 published by the Department of Agronomy; University of Nebraska - Lincoln.

situation where the 1972 established locations were a year ago. Most have reached equilibrium and a few have not. Those not yet at equilibrium are sites with the most free CaCO_3 present in them.

Refer to the 1976 progress report for a more detailed discussion of these experiments.

4. Residual Nitrate-Nitrogen Levels as Affected by N Carrier, Rate and Application Time.

The objective of the original experiment was to determine the relative effectiveness of sulfur coated urea compared to urea and to ammonium nitrate as N sources for winter wheat. Yield data were reported in the 1976 progress report for this experiment. After a twelve month fallow period the soil from each treatment was sampled to a depth of six feet and analyzed by one foot increments for NO_3^- -N content. The objective of the sampling was to determine if the carryover N from previous fertilization was related to the original treatments.

Data obtained are in Table 7. There were no observable differences in NO_3^- -N content of the soil that could be attributed to previous fertilizer treatments.

Table 1 - Grain yield, straw yield, N uptake and grain protein as influenced by N rate, N carrier and time of application in a wheat-sorghum-fallow system.

N RATE Fall Applied lbs/a	WHEAT Grain Yield				WHEAT Straw Yield				TOTAL N Uptake				Grain Protein			
	Carrier				Carrier				Carrier				Carrier			
	Urea	N-28 bu/A	AN	NH ₃	Urea	N-28 cwt/A	AN	NH ₃	Urea	N-28 #/A	AN	NH ₃	Urea	N-28 %	AN	NH ₃
0	75				63				109				10.5			
20	61	72	71	71	50	61	64	67	100	114	123	125	11.5	11.2	11.6	11.7
40	80	77	76	68	70	70	71	72	138	136	132	123	11.7	11.9	11.7	11.7
60	76	76	85	73	73	71	80	66	132	135	159	128	11.7	12.1	12.1	12.0
80	80	72	87	68	76	68	82	61	143	134	155	118	12.0	12.2	12.2	12.0
N RATE Spring Applied lbs/a	Grain Yield				Straw Yield				N Uptake				Grain Protein			
	Carrier				Carrier				Carrier				Carrier			
	Urea	N-28 bu/A	AN	NH ₃	Urea	N-28 cwt/A	AN	NH ₃	Urea	N-28 #/A	AN	NH ₃	Urea	N-28 %	AN	NH ₃
0	75				63				109				10.5			
20	70	74	74	68	65	66	70	59	124	122	126	116	12.0	11.3	11.8	11.6
40	61	73	77	63	66	64	66	54	112	109	127	105	11.5	9.6	11.2	11.3
60	66	64	75	64	73	65	79	61	141	119	160	122	12.7	12.0	12.8	12.0
80	72	68	74	66	73	67	74	57	141	129	151	113	12.4	12.3	12.8	11.7

Table 2 - Analysis of variance for the N rate, N carrier and time of application experiment grown in the wheat-sorghum-fallow system.

<u>SOURCE</u>	<u>GRAIN YIELD</u>	<u>STRAW YIELD</u>	<u>N UPTAKE</u>	<u>GRAIN PROTEIN</u>
Nitrogen (N)	N.S.	**	**	**
N_L	N.S.	**	**	**
N_Q	N.S.	++	N.S.	N.S.
Time (T)	*	++	N.S.	N.S.
N x T	N.S.	*	++	++
N_L x T	+	++	N.S.	N.S.
N_Q x T	N.S.	++	++	N.S.
Carrier (C)	**	**	**	++
N-28 vs. NH_3 Urea, AN	N.S.	N.S.	N.S.	++
NH_3 vs. Urea, AN	**	**	**	N.S.
Urea vs. AN	*	**	**	N.S.
N x C	N.S.	**	++	N.S.
T x C	N.S.	*	N.S.	*
N x T x C	N.S.	N.S.	N.S.	N.S.

N.S. denotes not significant

++ denotes significant at the 10% probability level

* denotes significant at the 5% probability level

** denotes significant at the 1% probability level

Table 3 - Grain and straw yields from six SW Nebraska phosphorus experiments in 1977.

LOCATIONS

	Jesch		Gardner 1		Kasson		Scharf		Gardner 2		Carter	
Phos Rate	Grain bu/A	Straw cwt/A	Grain bu/A	Straw cwt/A	Grain bu/A	Straw cwt/A	Grain bu/A	Straw cwt/A	Grain bu/A	Straw cwt/A	Grain bu/A	Straw cwt/A
0 #p/A	61	47	61	65	50	51	48	48	48	59	64	45
15	69	51	66	77	58	55	78	74	47	56	63	44
30	67	51	66	77	57	56	72	67	50	59	57	42
45	71	54	71	82	55	54	77	74	62	75	64	45
60	78	58	66	80	57	56	75	71	58	71	62	44
75	71	54	64	83	58	55	71	76	67	68	63	43
Soil Test												
Phos 0-4" ppm	6		7		10		11		11		30	
Phos 4-8" ppm	2		2		3		3		4		13	
pH 0-4"	7.1		6.0		6.3		5.8		7.6		6.6	
pH 4-8"	7.6		6.1		6.5		6.4		7.6		6.8	

Table 4 - Grain yields from three Panhandle Nebraska phosphorus experiments in 1977.

<u>LOCATION</u>						
	HAGSTROM		SATO		LERWICK	
<u>RATE</u>	<u>ROW</u>	<u>BROADCAST</u>	<u>ROW</u>	<u>BROADCAST</u>	<u>ROW</u>	<u>BROADCAST</u>
#P/A	bu/A		bu/A		bu/A	
0	21		24		28	
7.5	22	21	28	32	36	34
15	21	21	26	29	34	36
22.5	24	21	30	27	40	35
30	24	25	27	30	33	36
37.5	26	23	30	30	37	42
SOIL TEST						
Phos 0-4" ppm	8		6		14	
Phos 4-8" ppm	4		3		10	
pH 0-4"	8.0		8.2		8.0	
pH 4-8"	8.2		8.2		8.2	

Table 5 - Effect of time on residual P according to soil tests following different rates of P fertilization, Cheyenne County, Nebraska. Established September, 1972.

Applied P	pH	Bray initial P(1972)	Residual P							
			Spring 1974 NaHCO ₃ Bray		Spring 1975 NaHCO ₃ Bray		Spring 1976 NaHCO ₃ Bray		Spring 1977 NaHCO ₃ Bray	
lbs/A		ppm	ppm							
STEFFANS FARM										
	8.0	12								
25			12	14	10	14	6	12	13	19
50			19	23	9	15	8	15	14	21
100			22	27	14	21	8	20	14	22
500			79	86	36	41	18	46	26	47
PETERSON FARM #1										
	8.0	4								
25			9	11	10	14	6	10	9	12
50			17	17	12	16	9	15	14	18
100			32	40	16	25	16	28	16	26
200			76	70	39	48	36	70	31	53
OLSON (30) FARM #1										
	8.0	7								
25			10	11	7	12	8	8	11	13
50			16	13	8	13	9	9	13	10
100			21	19	11	15	13	11	12	14
500			38	26	36	43	22	24	19	26
EASTERLY FARM										
	8.1	4								
25			9	16	14	30	7	8	13	13
50			12	19	12	16	10	11	13	16
100			21	21	11	21	14	17	18	27
500			38	49	27	47	23	41	18	38
RADDATZ FARM #1										
	8.1	4								
25			14	20	13	29	9	14	15	23
50			17	28	27	55	10	19	15	24
100			31	43	9	20	10	18	23	36
500			67	74	33	67	26	48	44	69
KRIESEL FARM										
	8.1	4								
25			12	15	5	12	8	7	13	22
50			16	14	11	17	14	17	14	24
100			22	18	10	18	15	20	15	24
500			55	48	35	51	20	32	23	42
RIECKEN FARM										
	7.9	1.8								
25			16	1.5	14	3	16	1	18	1
50			20	1.7	18	2	19	1	18	1
100			29	1.8	24	1	24	3	17	1
500			56	2.6	48	3	42	3	15	1
NARJES FARM #1										
	7.7	14								
25			13	20	13	26		17	14	27
50			25	31	16	35		24	22	35
100			38	46	19	37		25	23	40
500			81	113	38	82		51	35	59

Table 6 - Effect of time on residual P according to soil tests following different rates of P fertilization, Cheyenne County, Nebraska. Established September, 1973.

Applied P	pH	NaHCO ₃ Bray initial P(1973)		Residual P					
				Spring 1975 NaHCO ₃ Bray		Spring 1976 NaHCO ₃ Bray		Spring 1977 NaHCO ₃ Bray	
lbs/A			ppm	----- ppm -----					
EGGING FARM									
	7.9	4	7						
25				13	7	10	6	10	7
50				16	11	12	11	13	18
100				24	15	18	9	15	9
500				60	57	39	54	33	50
HRUSKA FARMS									
	7.5	6	12						
25				8	18	11	17	10	15
50				9	22	11	17	9	12
100				15	27	36	22	20	33
500				70	133	53	73	57	75
PETERSON FARM #2									
	7.8	8	16						
25				13	27	11	17	13	20
50				26	43	19	30	17	27
100				40	65	25	44	21	34
500				140	273	78	106	64	77
WARREN JOHNSON FARM									
	8.0	6	13						
25				13	15	10	10	8	11
50				11	13	13	18	8	11
100				30	36	12	16	10	15
500				33	39	32	46	17	26
MUELLER FARM									
	7.0	7	13						
25				11	26	11	23	10	16
50				19	39	13	27	12	20
100				37	74	24	49	19	32
500				101	235	47	95	46	72
OLSON (30) FARM #2									
	8.0	5	5						
25				8	13	7	9	9	11
50				11	22	10	16	11	15
100				21	39	19	29	16	22
500				89	176	63	81	46	69
WENDELL JOHNSON									
	7.7	9	18						
25				16	35	12	24	13	24
50				20	31	16	31	14	27
100				30	44	30	43	18	34
500				105	220	55	78	43	69
NARJES FARM #2									
	8.2	6	5						
25				6	9	9	13	10	14
50				12	18	13	14	14	15
100				19	27	18	23	18	19
500				50	40	35	24	37	43
KJURZ FARM									
	7.0	8	17						
25				13	19	12	20	11	20
50				13	33	13	28	16	28
100				20	40	20	33	32	57
500				81	200	55	87	68	92
RADDATZ FARM #2									
	7.5	4	7						
25				10	20	8	13	8	12
50				18	35	13	22	12	17
100				27	44	17	30	17	24
500				88	196	54	68	57	79

PLANT LOSS OF NITROGEN

M. L. Hooker, G. A. Peterson
D. H. Sander

Introduction

The enigma of nitrogen balance sheets for soil systems has been recognized for a long time. Little attention has been given to the role of plant N losses in these balance sheets. This second possibility loss of nitrogen from living plants, was pointed out by Daigger et al (1976) when they monitored total nitrogen uptake by wheat. They found (Table 1) total nitrogen accumulation in the plant peaked around anthesis then decreased continuously until harvest. The observed decrease amounted to 30% of the total nitrogen accumulated in the plant at flowering. It should be noted that this decrease occurred during a period when plant senescence was beginning.

Some researchers have hypothesized that a possible pathway for this loss was through volatilization of ammonia, and/or amines, from the plant. Denmead et al (1974) found gaseous nitrogen losses over grazing systems that often were as high as 100 kg/ha annually. Later work by Denmead et al (1976) re-enforced this finding. They observed losses of 13 g/ha/hr from grazed pastures compared to 2 g/ha/hr over ungrazed systems. Hooker et al (1973) studied ammonia loss from grass sod vs freshly tilled native sod at two soil moistures (wilting point and field capacity). They found the highest loss of gaseous nitrogen was from the sod treatments. Greater nitrogen losses occurred from the wilting point treatment than from those kept at field capacity. It was noted that ammonia loss increased dramatically when plants began senescing. The greatest amounts of plant tissue senesced with the wilting point treatment.

Other possible pathways of nitrogen loss have been proposed, these being:
1) loss in dropped plant tissue, and 2) translocation back to the roots. Data from Daigger et al (1976) showed that the total amount of dry matter lost (Table 1) after flowering was less than the total nitrogen loss during the same period. Since

nitrogen makes up only a small percentage of the total dry matter weight of wheat the former proposed pathway could not account for the large nitrogen losses observed in Daigger's experiment.

Smith (1975) explored the possibility of translocation of nitrogen to the roots as the plants matured. He found that there was a decrease in the concentration of nitrogen in the roots throughout the sampling period, beginning shortly after vernalization and continuing to grain maturity. Smith concluded that the roots were not a sink for the nitrogen being lost by the above ground portions of the plant after heading.

This leaves the basically unexamined, gaseous nitrogen loss pathway as the prime suspect in the enigma of nitrogen balance sheets.

Table 1. Accumulation of dry matter and nitrogen as related to time of sampling.

<u>Time</u> (days before or after flowering)	<u>Dry Matter</u> (g/ha)	<u>Nitrogen</u> (kg/ha)
-34	17.9	62
-26	34.4	94
-16	54.8	100
-3	106.7	163
+9	93.6	122
+16	116.9	141
+23	113.5	128
+34	98.7	128

General Project Overview

The original project proposal suggested that gaseous nitrogen volatilization was of prime importance in the mechanism of nitrogen loss from a maturing wheat plant. It proposed that a system be developed for monitoring this loss, and that experiments be performed to attempt to quantitatively and qualitatively estimate gaseous nitrogen evolution.

The project funding began in the spring of 1975. The process of finding a company that could develop a growth chamber designed to meet the needs of the project was initiated. The Environmental Growth Chamber Company received the bid and engineered a chamber that was to be essentially air tight and could maintain temperatures at 4°C for long periods for wheat vernalization. Setup and sealing of the chamber was directed by EGC, was completed in the late summer of 1976. An extensive period of testing for air leaks and leakage rates followed and was continuously interrupted by failures in the cooling system plumbing. Early in 1977 the initial experiment was started and carried through to completion in the summer of 1977.

A second experiment was immediately begun but prematurely terminated due to further plumbing failures. Termination occurred shortly before the beginning of the nitrogen loss period. This last breakdown resulted in many circuits on the chamber being shorted out and down time may be in excess of eight months. Although project funds have now been terminated, the experimentation will continue until the questions proposed have been satisfactorily answered.

Experimental Results

Winter wheat was raised in the sealed growth chamber through its entire life cycle. Air purged of nitrogen-oxides ($\text{NO}+\text{NO}_2$) and ammonia (NH_3) was supplied to the plants from boot stage until grain maturity. During this same period the air exiting from the chamber was continuously sampled for any $\text{NO}+\text{NO}_2$ or NH_3 volatilized from the system. Throughout the sampling period no increase in $\text{NO}+\text{NO}_2$ gases could be detected. Some ammonia evolution did occur, however. This evolution continued at a constant, low rate from the boot stage until a few days after flowering (Fig. 1). At this point the rate of NH_3 volatilization more than tripled, and remained fairly constant through final harvest.

The stage at which NH_3 evolution increased in this experiment corresponds closely to the state that Daigger et al (1976) observed the initial decrease in total nitrogen accumulation in the plant. This lends strong support to the hypothesis that NH_3 volatilization may be the pathway of nitrogen loss.

The fact that the total nitrogen lost from the plants as NH_3 during this experiment was small may be explained by two factors: 1) the plant populations in the growth chamber were much lower than actually exist in the field, and 2) relative humidity in the chamber was higher than conditions in the field where nitrogen losses were observed. This last factor is supported by the findings of Denmead et al (1976) who observed greater NH_3 volatilization occurred when water evaporation was highest.

It is felt that evidence presented here supports the gaseous nitrogen loss hypothesis and is strong enough, in light of the above mentioned factors, to warrant continued experimentation.

Literature Cited

- Daigger, L. A., D. H. Sander, and G. A. Peterson. 1976. Nitrogen content of winter wheat during growth and maturation. Agr. Jour. 68:815-818
- Denmead, O. T., J. R. Freney, and J. R. Simpson. 1976. A closed ammonia cycle within a plant canopy. Soil Biol. Biochem. 8:161-164.
- Denmead, O. T., J. R. Simpson, and J. R. Freney. 1974. Ammonia flux into the atmosphere from a grazed pasture. Sci. 185:609-610.
- Hooker, M. L., G. A. Peterson, and D. H. Sander. 1973. Ammonia nitrogen losses from simulated plowing of native sods. SSSAP 37:247-249.
- Smith, T. L. 1975. The effect of available nitrogen and harvest time on the nitrogen distribution in the roots and tops of winter wheat. Masters Thesis University of Nebraska.

INFLUENCE OF APPLIED NITROGEN AND MOISTURE
ON TOTAL NUTRIENT UPTAKE AND ON ROOT ACTIVITY
OF SOYBEANS AS MEASURED BY ^{32}P

Bashir Alwan Al-Ithawi and R. A. Olson^{1/}

The activity of soybean (*Glycine max* (L.) Merrill) roots in different zones in the soil was measured by tagged phosphate throughout the growing season. The influence of soil moisture level, nitrogen rates and placement depth of tagged phosphate on root activity and nutrient uptake of N, P, K, Ca, Mg, Fe, Cu and Zn by the plant was measured also throughout the growing season at 18 and 21 day intervals for 1974 and 1976, respectively. Three placement depths of tagged phosphate (9", 18", 36") were used in this experiment with three rates of nitrogen fertilizer (0, 50 and 100 lb N/A) and three levels of soil moisture (0, 1 and 2 inches per application of water).

Experimental data show that soil moisture level had a great influence on grain yield of soybeans with 10 and 17 bu/A grain yield increases obtained under high level of soil moisture over low level of moisture in 1974 and 1976, respectively (Tables 1 and 2). Dry matter, percent plant P derived from fertilizer and nutrient uptake were also increased with increased soil moisture level. Placement depth of tagged phosphate had no effect on dry matter accumulation and grain yield of soybeans. Plant P derived from fertilizer was only moderately greater with 9-inch placement than with 18-inch and 36-inch placement depths in the 1974 experiment, while no difference existed between the three placement depths in the 1976 experiment evidencing the deep feeding capabilities of the soybean plant (Tables 3 and 4). Nitrogen fertilizer significantly increased grain yield of soybeans in 1974 but did not influence yield in 1976, the difference being attributable to the varied amount of residual mineral nitrogen in the respective soils. Dry matter accumulation, nitrogen content of the seed and the uptake of other nutrients under study were increased by nitrogen application (examples, Tables 5, 6, 7). Nitrogen influenced consumptive water use, the higher the rate of nitrogen applied the more water used by the plant.

^{1/} Abstract of Ph.D. thesis of the senior author.

Table 1. Grain yield of soybeans as influenced by soil moisture level, N rate and depth of P placement, 1974. (Sharpsburg soil with 74 lbs/a of residual mineral N in the 5-foot profile.)

Irrigation	Replication	Depth of placement (inches)								
		9			18			36		
		0	50	100	N rate, lb/A			0	50	100
Grain yield, bu/A										
Low	R ₁	43.9	48.4	49.5	46.2	47.1	50.0	46.0	45.7	50.9
	R ₂	47.5	41.3	48.5	44.0	46.5	49.0	48.4	46.5	53.2
	R ₃	45.6	45.0	47.9	43.6	47.5	51.3	44.2	45.6	49.8
	Avg.	45.7	44.9	48.3	44.6	47.0	50.1	46.2	45.8	51.3
	Avg. depth		46.3			47.2			47.7	
	Avg. N		N0 = 45.5				N50 = 45.9			N100 = 49.9
Medium	R ₁	50.2	54.6	58.9	43.2	58.6	59.7	50.1	55.7	59.0
	R ₂	53.8	55.8	55.7	55.0	60.2	59.8	52.1	57.2	60.2
	R ₃	50.8	53.6	58.8	53.2	56.9	55.9	51.3	53.9	58.9
	Avg.	51.6	54.7	57.8	53.8	58.9	58.5	51.2	55.6	59.1
	Avg. depth		54.7			57.0			55.3	
	Avg. N		N0 = 52.2				N50 = 56.4			N100 = 58.5
High	R ₁	52.7	58.4	60.0	50.5	56.3	60.0	53.2	56.2	51.7
	R ₂	55.0	57.6	61.0	53.5	58.9	58.9	54.4	60.2	58.0
	R ₃	53.4	57.8	62.3	50.5	58.2	61.8	55.3	60.0	60.0
	Avg.	53.7	57.9	61.1	51.5	57.8	60.9	54.3	58.8	59.9
	Avg. depth		57.6			56.7			57.6	
	Avg. N		N0 = 53.2				N50 = 58.2			N100 = 60.6

Table 2. Grain yield of soybeans as influenced by soil moisture level, N rate and depth of P placement, 1976. (Sharpsburg soil with 132 lbs/a of residual mineral N in the 5-foot profile.)

		Depth of placement (inches)								
		9			18			36		
Irrigation	Replication	0	50	100	N rate, lb/A			0	50	100
		0	50	100	0	50	100	0	50	100
		Grain yield, bu/A								
Low	R ₁	32.4	12.6	38.0	28.0	35.1	37.1	31.9	32.3	31.6
	R ₂	29.4	23.0	37.0	35.3	38.5	34.7	33.9	37.6	37.6
	R ₃	22.1	27.3	22.8	20.8	24.9	28.9	24.1	22.6	26.4
	Avg.	28.0	31.0	32.5	28.0	32.8	33.6	30.0	30.8	31.4
	Avg. depth		30.5			31.5			30.8	
	Avg. N		NO = 28.6			N50 = 31.5			N100 = 32.7	
Medium	R ₁	52.9	48.4	63.4	49.3	43.5	56.3	48.4	39.5	48.3
	R ₂	40.8	42.5	42.5	37.0	35.0	38.2	34.3	39.0	35.4
	R ₃	37.5	38.2	33.8	30.0	33.9	43.5	35.0	39.7	36.5
	Avg.	43.7	43.0	46.6	38.8	37.5	46.0	34.2	39.4	40.0
	Avg. depth		44.4			40.8			39.5	
	Avg. N		NO = 40.6			N50 = 39.9			N100 = 43.2	
High	R ₁	49.7	49.3	58.1	55.7	44.0	52.5	50.0	43.0	54.1
	R ₂	50.4	47.3	54.5	52.0	44.1	51.4	50.9	56.9	55.2
	R ₃	42.0	44.8	38.7	36.3	45.2	42.0	37.8	37.3	40.2
	Avg.	47.4	47.1	50.4	48.0	46.1	48.6	46.2	45.7	49.8
	Avg. depth		48.3			47.6			47.2	
	Avg. N		NO = 47.2			N50 = 46.3			N100 = 49.6	

Table 3. Percentage of plant P derived from fertilizer throughout the growing season in the above ground plant material of soybeans as influenced by soil moisture level, N rate and depth of P placement, 1974.

Irrigation	Date of plant sampling	Depth of placement (inches)								
		9			18			36		
		0	50	100	N rate, lb/A			0	50	100
					0	50	100			
		% P derived from fertilizer								
Low	7/8	8.4	7.5	8.7	5.6	7.8	7.0	4.0	2.4	3.0
	7/23	12.3	10.1	10.3	11.3	8.3	8.2	6.8	6.7	6.8
	8/12	13.0	13.2	15.3	13.3	9.3	12.1	8.5	9.3	10.3
	8/30	13.2	14.6	15.3	13.4	10.9	12.8	10.0	10.8	13.9
	9/18	13.2	14.9	15.7	14.1	13.9	14.8	10.9	10.5	14.8
	10/6 seed	10.0	10.5	12.3	9.5	16.2	8.0	6.3	6.4	8.7
	10/6 veg.	0.0	3.5	3.2	3.8	0.0	6.3	3.8	3.6	6.2
Medium	7/8	9.7	12.5	14.3	7.4	7.9	4.5	2.6	2.2	2.8
	7/23	11.1	15.7	15.8	9.2	9.8	8.0	8.7	7.4	8.8
	8/12	16.8	14.8	23.6	11.3	13.5	10.8	10.6	10.1	11.1
	8/30	17.3	18.6	23.4	12.9	14.8	15.6	12.2	12.9	16.8
	9/18	17.9	17.5	24.3	13.1	14.9	16.2	13.3	12.8	16.8
	10/6 seed	10.1	10.8	13.7	7.1	10.9	9.1	7.6	10.0	10.3
	10/6 veg.	6.7	3.3	9.5	6.5	3.2	6.1	0.0	3.2	6.1
High	7/8	12.1	13.1	13.3	9.0	7.8	8.5	7.8	7.7	8.0
	7/23	18.7	16.7	15.7	15.3	13.4	10.4	8.6	9.9	11.3
	8/12	18.6	17.8	18.3	11.1	16.9	16.1	10.9	13.4	14.9
	8/30	17.9	18.0	18.8	13.3	15.9	17.1	12.7	14.8	16.9
	9/18	18.8	17.5	21.6	13.6	15.8	18.2	13.3	16.5	18.8
	10/6 seed	12.1	10.5	13.8	9.9	9.0	12.0	8.2	9.5	11.5
	10/6 veg.	3.1	3.2	6.1	3.1	3.2	5.8	3.2	6.3	5.8

Table 4. Percentage of plant P derived from fertilizer throughout the growing season in the above ground plant material of soybeans as influenced by soil moisture level, N rate and depth of P placement, 1976.

Irrigation	Date of plant sampling	Depth of placement (inches)								
		9			18			36		
		0	50	100	N rate, lb/A			0	50	100
		0	50	100	0	50	100	0	50	100
% P derived from fertilizer										
Low	7/8	5.7	4.5	3.1	2.2	2.0	2.3	1.7	2.7	1.7
	7/29	9.5	10.0	11.9	6.9	6.4	6.4	4.7	6.5	6.5
	8/23	19.1	18.0	19.5	16.1	17.1	15.4	17.2	17.5	16.8
	9/13	19.5	21.0	18.6	20.0	17.0	19.0	18.3	20.5	21.6
	10/6 seed	10.8	8.8	10.2	8.4	8.8	9.8	9.9	9.3	8.8
	10/6 veg.	7.0	7.7	7.6	8.0	7.0	7.0	7.1	10.3	9.0
Medium	7/8	4.7	3.1	5.5	2.1	1.7	1.4	1.6	1.7	1.7
	7/29	10.0	15.0	14.2	5.3	7.6	8.0	5.0	5.3	4.8
	8/23	22.0	21.5	21.7	20.1	20.0	20.8	19.7	18.7	20.6
	9/13	25.4	30.0	28.0	24.5	24.8	25.8	23.2	22.5	24.0
	10/6 seed	10.8	10.2	10.0	10.8	11.4	11.1	9.0	12.3	10.0
	10/6 veg.	7.0	6.0	8.5	7.2	8.0	8.5	8.5	9.7	9.7
High	7/8	6.9	6.6	4.2	1.9	4.3	1.9	1.4	1.4	1.4
	7/29	11.0	15.5	16.7	5.0	7.4	10.0	4.4	5.9	5.3
	8/23	21.8	23.1	26.8	18.8	20.6	20.8	20.1	21.2	22.0
	9/13	25.5	27.1	28.5	24.0	25.0	24.5	20.6	22.6	20.9
	10/6 seed	11.0	12.7	12.3	10.9	11.7	11.6	10.7	10.8	11.3
	10/6 veg.	9.0	8.6	8.2	8.5	8.7	8.6	9.5	9.1	10.9

Table 5. Phosphorus accumulation throughout the growing season in the above ground plant material of soybeans as influenced by soil moisture, N rate and depth of P placement, 1976.

Irrigation	Date of plant sampling	Depth of placement (inches)								
		9			18			36		
		0	50	100	N rate, lb/A			0	50	100

Table 6. Magnesium accumulation throughout the growing season in the above ground plant material of soybeans as influenced by soil moisture level, N rate and depth of P placement, 1974.

Irrigation	Date of plant sampling	Depth of placement (inches)								
		9			18			36		
		0	50	100	N rate, lb/A			0	50	100
					0	50	100			
Mg yield, lb/A										
Low	7/8	3.8	4.3	4.6	4.4	4.5	5.4	4.0	4.8	4.9
	7/23	4.9	5.0	5.8	3.6	6.3	7.5	4.8	5.0	5.8
	8/12	6.5	7.1	8.1	8.6	9.1	9.9	7.4	7.9	9.5
	8/30	11.9	12.9	14.7	14.0	15.3	16.6	12.4	15.7	17.8
	9/18	16.7	18.9	20.9	18.0	21.9	23.9	16.5	15.7	22.4
	10/6 seed	7.1	6.8	8.1	7.9	8.3	8.3	6.7	8.1	9.5
	10/6 veg.	3.9	4.4	4.8	3.1	4.8	5.2	3.8	5.2	4.9
Medium	7/8	4.3	5.3	6.7	4.9	5.5	6.9	4.9	4.3	5.6
	7/23	7.8	6.9	9.3	7.3	8.4	10.7	6.0	7.1	8.9
	8/12	10.4	13.1	15.1	9.6	13.7	14.6	10.3	12.8	13.2
	8/30	19.6	17.8	21.2	16.0	17.9	22.5	17.2	23.3	22.8
	9/18	22.5	23.2	28.1	19.2	24.5	27.2	19.6	26.3	28.6
	10/6 seed	8.6	10.0	11.4	8.5	10.0	11.5	7.6	10.3	11.8
	10/6 veg.	7.3	8.1	9.9	6.4	8.1	10.2	6.7	8.3	9.4
High	7/8	5.2	5.3	6.9	4.9	6.3	6.4	5.2	5.9	6.9
	7/23	9.4	10.5	12.4	9.2	10.9	11.0	7.8	10.3	11.1
	8/12	10.2	13.5	15.7	11.5	14.9	16.3	12.3	14.6	15.1
	8/30	19.3	18.9	22.7	17.7	19.8	20.3	19.8	21.4	21.3
	9/18	21.9	27.3	27.6	20.3	25.3	29.5	21.9	26.0	28.0
	10/6 seed	9.8	10.5	11.7	8.0	10.8	11.7	9.9	11.3	11.9
	10/6 veg.	7.8	9.0	9.6	7.0	9.5	9.9	7.4	9.7	10.2

Table 7. Zinc accumulation in the soybean seed as influenced by soil moisture level, N rate and depth of P placement, 1974.

Irrigation	Replication	Depth of placement (inches)								
		9			18			36		
		0	50	100	N rate, lb/A			0	50	100
					0	50	100			
Zn yield, lb/A										
Low	R1	.065	.055	.072	.081	.078	.084	.073	.076	.080
	R2	.077	.076	.091	.070	.082	.096	.087	.074	.089
	R3	.071	.068	.080	.073	.082	.093	.075	.074	.082
	Avg.	.071	.066	.081	.074	.080	.091	.078	.075	.084
	Avg. depth		.072			.082			.078	
	Avg. N		N0 = .075			N50 = .074			N100 = .085	
Medium	R1	.086	.093	.111	.085	.089	.099	.083	.098	.105
	R2	.094	.097	.094	.089	.084	.111	.091	.097	.101
	R3	.089	.092	.098	.085	.085	.098	.088	.095	.105
	Avg.	.090	.094	.101	.086	.088	.103	.087	.097	.104
	Avg. depth		.095			.096			.096	
	Avg. N		N0 = .088			N50 = .097			N100 = .102	
High	R1	.074	.090	.086	.087	.096	.105	.098	.081	.098
	R2	.089	.092	.107	.083	.093	.099	.090	.096	.093
	R3	.083	.092	.101	.086	.096	.104	.097	.094	.097
	Avg.	.082	.091	.098	.085	.095	.102	.095	.090	.096
	Avg. depth		.090			.094			.094	
	Avg. N		N0 = .087			N50 = .092			N100 = .099	

UTILIZATION OF ^{15}N FERTILIZER BY NODULATING AND
NON-NODULATING SOYBEAN ISOLINES

E. J. Deibert and R. A. Olson^{1/}

ABSTRACT

Nitrogen tracer research with soybeans (*Glycine Max* (L.) Merrill) is essential to understand the complex soil-plant N system balance among symbiotically fixed, residual soil or applied fertilizer N to achieve maximum yields. Tracer ^{15}N enriched fertilizer was used to measure the fraction of N in nodulating (Ford A62-5) and non-nodulating (Ford A62-6) soybean isolines derived from these three sources. Plant samples were collected at full bloom, bean fill and seed harvest stages in a field experiment conducted at the University of Nebraska Mead Field Lab on Sharpsburg soil of 3.3% organic matter content. Nitrogen fertilizer rates of 45, 89 and 134 kg/ha applied at planting or delayed until full bloom growth stage were evaluated.

Dry matter production of both isolines at full bloom was increased by N fertilizer applications but at bean fill, dry matter was not significantly changed by N fertilizer (Table 1). Nitrogen fertilizer had no significant influence on weight, yield or N and oil concentration of the nodulating isoline seed but increased these variables of the non-nodulating isoline, with the delayed N fertilizer application showing a distinct advantage. Fertilizer utilization by both isolines at later growth stages increased as fertilizer rate increased, contrary to N utilization patterns of other crops (Table 2).

"A" value increases with increased N fertilizer rates suggested a soil N priming or root extension effect. Increasing N fertilizer rates increased the portion of total plant N in the seed derived from the fertilizer but had essentially no effect on amounts obtained from the soil (Table 3). Less plant N in the nodulating line came from the soil with a delayed N fertilizer application. Fertilizer rates applied at planting above 45 kg N/ha reduced the symbiotically fixed N fraction while delaying the fertilizer application, irrespective of rate, had no influence.

^{1/} Abstract of PhD thesis of the senior author.

Table 1. Yield, N concentration and total N of full bloom stage and bean fill stage total dry matter and harvested seed of nodulating and non-nodulating Fomsoybean isolines as influenced by N fertilizer application time and rate.

N Fertilizer		Total Dry Matter				Harvested Seed	
Application Time	Rate Kg/ha	Full Bloom Stage		Bean Fill Stage		Nod	Non-Nod
		Nod	Non-Nod	Nod	Non-Nod		
<u>Yield (kg/ha)</u>							
	0	2400 a	2105 a	6706 a	5378 a	2920 a	1300 a
Planting	45	2863 b	2584 b	6801 a	5737 a	3127 a	1747 b
	89	2880 b	2737 b	7870 b	7270 c	2813 a	2307 c
	134	3222 c	3132 c	7355 ab	6813 bc	3040 a	2380 c
Full Bloom	45	--	--	7272 ab	6219 ab	2787 a	2153 c
	89	--	--	7430 ab	6279 abc	2913 a	2527 cd
	134	--	--	7505 ab	7134 bc	3113 a	2840 d
<u>N Concentration (%)</u>							
	0	3.32 a	2.58 a	2.62 abc	1.30 a	6.13 a	4.61 a
Planting	45	3.44 ab	3.47 b	2.53 ab	1.92 b	6.37 a	4.73 ab
	89	3.72 ab	3.55 b	2.69 bcd	2.14 bc	6.28 a	4.97 abc
	134	3.93 b	3.65 b	2.41 a	2.51 d	6.47 a	5.11 bc
Full Bloom	45	--	--	2.91 d	2.02 bc	6.48 a	4.98 abc
	89	--	--	2.85 cd	2.21 c	6.40 a	5.21 c
	134	--	--	2.95 d	2.56 d	6.38 a	5.32 c
<u>Total N (kg/ha)</u>							
	0	81 a	55 a	178 ab	70 a	157 a	53 a
Planting	45	99 b	89 b	174 a	111 b	175 a	73 ab
	89	108 bc	97 b	214 bc	148 cd	156 a	101 c
	134	128 c	115 c	180 ab	172 de	172 a	108 c
Full Bloom	45	--	--	214 bc	126 bc	159 a	95 bc
	89	--	--	213 bc	140 bcd	164 a	115 cd
	134	--	--	223 c	184 e	174 a	133 d

Table 2. Atom % ^{15}N , N fertilizer utilization and 'A' values of full bloom stage and bean fill stage total dry matter and harvested seed of nodulating and non-nodulating Ford soybean isolines as influenced by N fertilizer application time and rate.

N Fertilizer		Total Dry Matter					
Application Time	Rate kg/ha	Full Bloom Stage		Bean Fill Stage		Harvested Seed	
		Nod	Non-Nod	Nod	Non-Nod	Nod	Non-Nod
<u>Atom % ^{15}N</u>							
	0	0.406	0.391	0.364	0.371	0.364	0.366
Planting	45	0.849	0.903	0.569	0.743	0.493	0.708
	89	1.024	1.108	0.840	0.962	0.743	0.938
	134	1.144	1.266	0.984	1.298	0.947	1.210
Full Bloom	45	--	--	0.524	0.870	0.521	0.826
	89	--	--	0.822	1.232	0.656	1.083
	134	--	--	0.946	1.252	0.845	1.353
<u>N Fertilizer Utilization (%)</u>							
	0	--	--	--	--	--	--
Planting	45	49.3 b	51.2 b	39.1 a	45.5 a	25.6 a	27.3 a
	89	37.6 a	39.1 a	56.0 c	48.5 a	32.3 ab	31.4 b
	134	35.5 a	37.7 a	41.4 ab	59.1 ab	37.0 b	33.5 b
Full Bloom	45	--	--	37.7 a	70.1 b	27.6 a	47.9 c
	89	--	--	53.4 bc	66.9 b	26.4 a	45.8 c
	134	--	--	47.9 abc	60.0 a	30.9 ab	47.9 c
<u>'A' Value</u>							
	0	--	--	--	--	--	--
Planting	45	140 a	115 a	355 b	177 bc	602 c	199 a
	89	178 b	147 ab	260 a	192 c	351 a	206 a
	134	201 b	154 b	272 a	141 abc	297 a	168 a
Full Bloom	45	--	--	466 c	122 ab	474 b	138 a
	89	--	--	287 a	108 a	473 b	151 a
	134	--	--	303 ab	154 abc	384 a	129 a

Table 3. Portion of total N in full bloom stage and bean fill stage total dry matter and harvested seed of nodulating and non-nodulating Ford soybean isolines derived from the fertilizer, soil or symbiotically fixed as influenced by N fertilizer application time and rate.

N Fertilizer Application Rate Time kg/ha		Total Dry Matter								
		Full Bloom Stage			Bean Fill Stage			Harvested Seed		
		N Source			N Source			N Source		
		Fertilizer	Soil	Fixed	Fertilizer	Soil	Fixed	Fertilizer	Soil	Fixed
----- kg/ha -----										
<u>Nodulating</u>										
	0	--	55	26	--	70	108	--	53	104
Planting	45	22 a	64 a	13 a	18 a	78 b	78 bc	11 a	57 ab	106 b
	89	34 b	61 a	13 a	50 bc	121 c	43 a	29 b	75 b	52 a
	134	48 c	61 a	19 a	56 bc	66 ab	58 ab	49 d	69 ab	54 a
Full Bloom	45	--	--	--	16 a	52 a	146 d	12 a	43 a	104 b
	89	--	--	--	47 b	64 ab	102 c	24 b	45 a	95 b
	134	--	--	--	64 c	83 b	76 abc	42 c	45 a	87 b
<u>Non-Nodulating</u>										
	0	--	55	--	--	70	--	--	53	--
Planting	45	23 a	66 a	--	20 a	91 ab	--	12 a	60 a	--
	89	35 b	62 a	--	44 b	104 b	--	28 b	72 a	--
	134	50 c	65 a	--	79 d	93 ab	--	45 c	62 a	--
Full Bloom	45	--	--	--	31 ab	95 ab	--	21 b	74 a	--
	89	--	--	--	60 c	80 a	--	41 c	74 a	--
	134	--	--	--	81 d	103 b	--	64 d	69 a	--

EFFECT OF P, K, AND S ON THE YIELD OF IRRIGATED ALFALFA GROWN ON A SILT LOAM SOIL.

G.W. Rehm

Objective:

Stimulated by favorable prices for farm commodities and 3 years of dry weather, there has been a rapid development of irrigation in the loess soils of northeast Nebraska. It is anticipated that, as prices change, more acres will be devoted to irrigated alfalfa. However, there is limited data defining the nutrient requirements for maximum production of irrigated alfalfa. The objective of this study was to measure the effect of P, K, and S on the yield of irrigated alfalfa grown on a silt loam soil.

Procedure:

An experimental site was selected in Wayne County. Soil properties are listed in Table 1. Alfalfa was seeded in the spring of 1976. Treatments were topdressed to the established stand in the spring of 1977. Using a central composite factorial design, treatments were selected from a 5² complete factorial. Rates of P (supplied as 15-62-0) were 0, 15, 30, 45, 60 lb./acre. Potassium (supplied as 0-0-62) rates were 0, 40, 80, 120, 160 lb./acre. The rates of S (supplied as granular gypsum) were 0, 20, 40, 60, 80 lb./acre.

Four cuttings were harvested during the growing season. Whole plant samples were collected from each cutting for determination of moisture and nutrient content.

Table 1. Properties of the soil at the experimental site.

Soil type - - - - -	Nora silt loam
pH - - - - -	6.8
Available P (Bray), ppm - - - - -	5.3
Exchangeable K, ppm - - - - -	139
Hot Water Soluble Boron, ppm - - - - -	.62
SO ₄ -S, ppm - - - - -	10.5
Organic Matter Content, % - - - - -	2.38
Cation Exchange Capacity, me/100gm - - - - -	23.85

Results and Conclusions:

Total production for the 1977 growing season averaged 5.54 ton of dry matter per acre. The application of P increased the total yield for the growing season (Table 2). The use of P increased yields for the 1st and 3rd cuttings but had no effect on the yield of the 2nd and 4th cuttings. The response to P was linear. The application of K and S had no effect on yield throughout the growing season.

Table 2. Effect of applied P on the total yield of irrigated alfalfa for 1977.

P Applied lb./acre	Yield ton of dry matter per acre
0	5.34
15	5.47
30	5.57
45	5.64
60	5.66

EFFECT OF RATE OF BORON APPLIED TO ALFALFA GROWN ON AN IRRIGATED SILT LOAM

G.W. Rehm

Objective:

As irrigation continues to develop in the loess hills of northeast Nebraska, more acres will be devoted to the production of irrigated alfalfa. Yet, data defining the optimum rates of nutrients needed for maximum production of irrigated alfalfa are limited. The objective of this study was to measure the effect of boron applied to irrigated alfalfa grown on a silt loam soil.

Procedure:

An experimental site was selected in Wayne County. Soil properties are listed in Table 1. Alfalfa was seeded in the spring of 1976. Treatments were topdressed to the established stand in the spring of 1977. Rates of boron were 0, .5, 1.0, 1.5, and 2.0 lb. boron/acre applied as borax. All treatments received 30 lb. P/acre as 0-46-0, 60 lb. K/acre as 0-0-60, and 100 lb. S/acre as granular sypsum. Four cuttings were taken throughout the growing season.

Table 1. Properties of the soil at the experimental site.

Soil type - - - - -	Nora silt loam
pH - - - - -	6.8
Available P (Bray), ppm - - - - -	5.3
Exchangeable K, ppm - - - - -	139
SO ₄ -S, ppm - - - - -	10.5
Organic Matter Content, % - - - - -	2.38
Cation Exchange Capacity, me/100gm - -	23.85

Results and Conclusions:

Total production for the 1977 growing season averaged 5.56 ton of dry matter per acre. Yields for individual cuttings as well as total yields were not influenced by the application of boron (Table 2). The boron content of this soil is apparently sufficient to meet the boron requirements of the irrigated alfalfa crop.

Table 2. Effect of rate of boron on the yield of irrigated alfalfa.

Applied Boron lb./acre	Cutting				Total
	1st	2nd	3rd	4th	
	- - - - - ton dry matter/acre - - - - -				
0	1.94 a*	1.38 a	1.52 a	.58 a	5.42 a
.5	2.24 a	1.37 a	1.44 a	.54 a	5.68 a
1.0	2.10 a	1.39 a	1.52 a	.62 a	5.63 a
1.5	2.03 a	1.47 a	1.45 a	.59 a	5.53 a
2.0	2.17 a	1.35 a	1.44 a	.55 a	5.51 a

* Treatment means in any one column followed by the same letter are not significantly different at the .05 confidence level.

Fertilizer Requirements For Pasture Renovation Practices On Silt Loam Soils

G.W. Rehm, R.S. Moomaw

Objective:

Approximately 1/2 of Knox County is devoted to pastures. The majority of these pastures are abused and overgrazed. In addition to fertilization, many pastures need renovation. With current practices, land which is renovated and reseeded cannot be grazed for several years after seeding. There is a need to develop renovation procedures which utilize minimum or reduced tillage techniques. The objective of this study was to evaluate the effect of minimum tillage practices and application of fertilizer after grass establishment on the production of improved species of grasses and legumes.

Procedures:

The soil at the experimental site selected in Knox County was classified as a Nora silt loam. Existing vegetation was killed in the fall of 1974 by the application of glyphosate at a rate of 2 lb. a.i./acre. Seeding without prior tillage with the John Deere Grassland Drill was attempted in late April of 1975. This drill would not penetrate the soil leaving seeds on the soil surface. Therefore, a seedbed was prepared by using a PTO driven tiller. The Grassland Drill was used to seed into this seedbed.

A satisfactory stand of both intermediate wheatgrass and meadow brome were obtained with this seeding method. Rates of N and P selected from a 5² factorial to fit a central composite design were broadcast to these established stands in mid-April of 1976 and 1977. In addition, the same rates of N and P were applied to the native vegetation which existed prior to the start of the renovation studies. Plots were harvested in mid-June each year.

Results and Conclusions:

Yields recorded in 1977 are listed in Tables 1, 2, and 3. In 1977, the native vegetation responded to N but applied P had no effect on yield. The response to N was linear. The application of N produced a linear increase in the yield of intermediate wheatgrass. This grass did not respond to the application of P in 1977. For the meadow brome, there was a curvilinear response to applied N and a linear response to applied P. Fertilizer treatments will be reapplied in future yields and conclusions will be made after further data has been collected.

Table 1. Effect of N and P₂O₅ on dry matter produced by "native" vegetation. Knox County, 1977.

		N Applied (lb./acre)				
		0	40	80	120	160
		----- ton/acre -----				
lb. P ₂ O ₅ per acre	0	.55	.82	1.03	1.17	1.24
	28	.75	1.03	1.23	1.37	1.45
	55	.82	1.09	1.30	1.44	1.51
	83	.76	1.03	1.23	1.37	1.44
	110	.56	.83	1.03	1.16	1.24

Table 2. Effect of applied N and P₂O₅ on the dry matter yield of intermediate wheatgrass. Knox County, 1977.

		N Applied (lb./acre)				
		0	40	80	120	160
		-----ton/acre-----				
lb. P ₂ O ₅ per acre	0	.86	1.36	1.66	1.74	1.61
	28	1.00	1.55	1.87	1.99	1.90
	55	1.04	1.61	1.98	2.14	2.08
	83	.96	1.57	1.98	2.17	2.15
	110	.77	1.42	1.86	2.09	2.11

Table 3. Effect of applied N and P₂O₅ on the dry matter yield of meadow brome. Knox County, 1977.

		N Applied (lb./acre)				
		0	40	80	120	160
		-----ton/acre-----				
lb. P ₂ O ₅ per acre	0	.67	1.57	2.00	1.94	1.40
	28	.48	1.41	1.87	1.84	1.33
	55	.44	1.40	1.87	1.89	1.41
	83	.55	1.54	2.05	2.09	1.64
	110	.80	1.83	2.37	2.44	2.02

Fertilizer Requirements For Pasture Renovation Practices On Sandy Soils

G.W. Rehm and R.S. Moomaw

Objective:

Pastures on the sandy soils of northeast Nebraska are overgrazed and non-productive. Some can be improved through fertilization. The large majority, however, need renovation. Current renovation practices and procedures require that the land be removed from production for some time. There is a need to develop renovation procedures which involve minimum or reduced tillage practices. The objective of this study was to evaluate the effect of minimum tillage practices and application of fertilizer after grass establishment on the production of improved species of grasses and legumes.

Procedure:

The soil at the experimental site selected in Pierce County was classified as a Thurman loamy fine sand. Existing vegetation was killed by the application of glyphosate of 2 lb. a.i. per acre in mid-April of 1975. Several grass and grass-legume mixtures were seeded in early-May with a John Deere Grassland Drill. Drought prevented successful establishment of several of the seeded mixtures. We were successful in getting adequate stands of two grass mixtures. The two mixtures were:

1. big bluestem, sideoats grams, and sand lovegrass
2. little bluestem, indianagrass, and sand lovegrass

Rates of N and P selected from a 5^2 factorial to fit a central composite factorial design were broadcast to the established stands of the two mixtures in late May of 1976 and 1977. In addition, the same rates of N and P were applied to the vegetation which existed before the renovation procedure was started. Since this vegetation was dominated by cool-season species, the fertilizer was applied in mid-April each year.

The native, cool-season species were harvested in mid-June and the introduced mixtures of warm-season species were harvested in mid-August.

Results and Conclusions:

Properties of the soils at the experimental site are listed in Table 1. In 1977, the seeded mixtures as well as the native vegetation responded to the application of both N and P (Tables 2, 3, 4). In all cases, the response to P was linear while the response to N was curvilinear. There was no significant interaction in all situations. For the seeded mixtures, the application of both N and P produced a 4 to 5 fold increase in yield. Dry matter production from the seeded mixtures was substantially higher than dry matter production from the fertilized native species.

This study will be continued for several years and final conclusions will be presented at that time.

Table 1. Properties of the soil at the experimental site.

Soil Type	- - - - -	Thurman loamy fine sand
pH	- - - - -	7.1
Buffer pH	- - - - -	7.0
NO ₃ -N (lb./acre)	- - - - -	14
Phosphorus (Bray), ppm	- - - - -	3
Potassium, ppm	- - - - -	143
Organic Matter %	- - - - -	1.2
SO ₄ -S, ppm	- - - - -	less than 3.0

Table 2. Effect of application of N and P₂O₅ on dry matter yield of a mixture of big bluestem, sideoats grama, and sand lovegrass. Pierce Co. 1977.

		N Applied (lb./acre)				
		0	40	80	120	160
		- - - - - ton/acre - - - - -				
lb. P ₂ O ₅ per acre	0	.51	1.97	2.77	2.93	2.43
	28	.50	1.99	2.83	3.02	2.56
	55	.52	2.05	2.93	3.16	2.74
	83	.59	2.15	3.07	3.34	2.95
	110	.69	2.29	3.25	3.55	3.21

Table 3. Effect of application of N and P₂O₅ on dry matter yield of a mixture of little bluestem, indiagrass, and sand lovegrass. Pierce Co., 1977.

		N Applied (lb./acre)				
		0	40	80	120	160
		- - - - - ton/acre - - - - -				
lb. P ₂ O ₅ per acre	0	.89	2.32	3.10	3.26	2.78
	28	.76	2.22	3.04	3.23	2.77
	55	.73	2.21	3.07	3.29	2.87
	83	.78	2.31	3.19	3.44	3.06
	110	.94	2.49	3.41	3.69	3.33

Table 4. Effect of application of N and P₂O₅ on dry matter yield of the "native" vegetation. Pierce Co., 1977.

		N Applied (lb./acre)				
		0	40	80	120	160
		- - - - - ton/acre - - - - -				
lb. P ₂ O ₅ per acre	0	.02	.70	1.06	1.09	.81
	28	.13	.80	1.14	1.16	.85
	55	.24	.89	1.21	1.22	.90
	83	.35	.98	1.29	1.28	.94
	110	.46	1.07	1.37	1.34	.99

FOLIAR FERTILIZATION OF SOYBEANS

Ed Penas

Objective: To determine the effect of foliar application of fertilizer on seed yield of soybeans.

Procedure: Six sites were selected in farmers fields in East-central Nebraska. Fertilizer was prepared as reported by Iowa State University using potassium polyphosphate, potassium sulfate, urea and water. Two grades were used. A 10-2.4-4.0-0.6S as suggested by Iowa State and a 5-1.2-2.0-0.3S. Both grades were applied at a rate to give equal rates of nutrient per application. The diluted material was used to reduce the degree of leaf burning which was observed in 1976.

Results: Data are shown in the table. Total number of sprayings applied are indicated. The total pounds of nutrient applied and seed yields for each treatment at each site are given.

Discussion: Dilution of the fertilizer material did reduce the degree of leaf burning observed; however, seed yield was not increased by fertilizer regardless of the fertilizer grade used. Seed yield was significantly reduced at 3 of the 6 locations. In two cases, the yield reduction was greatest with the higher analysis material even though both materials were applied at the same rate of actual nutrient.

FOLIAR FERTILIZATION OF SOYBEANS, 1977

FERTILIZER APPLICATION RATES

County & Cooperator	No. of Sprays	Nutrients Applied, lbs/ac* Using							
		10-2-4				5-1-2			
		N	P ₂ O ₅	K ₂ O	S	N	P ₂ O ₅	K ₂ O	S
Butler									
Andel	3	73	17	29	4.4	71	17	28	4.2
Hermesen	2	50	12	20	3.0	49	12	20	3.0
Dodge									
Wagner	3	55	13	22	3.3	54	13	21	3.2
Sarpy									
Leaders	3	70	17	28	4.2	66	16	26	3.9
Trumble	3	81	20	33	4.9	75	18	30	4.5
Saunders									
Vermeline	3	67	16	27	4.0	68	16	27	4.1

*Suggested application per spraying: 25 N - 6 P₂O₅ - 10 K₂O - 1.5 S.

SEED YIELDS, BU/ACRE

County & Cooperator	Variety	Treatments			Response
		None	10-2-4	5-1-2	
Butler					
Andel	Wayne	39.8	35.7	37.7	Minus
Hermesen	Amsoy 71	50.3	49.5	48.2	None
Dodge					
Wagner	Amsoy 71	70.5	62.6	68.3	Minus
Sarpy					
Leaders	Dixon	40.4	43.2	41.4	None
Trumble	Calland	39.8	39.6	41.6	None
Saunders					
Vermeline	Wayne	43.2	40.8	40.6	Minus

FOLIAR FERTILIZER ON FIELD BEANS

Louis Daigger

Three fertilizer solutions were sprayed on field beans on the Panhandle Station. Materials were potassium polyphosphate mixed with urea and potassium sulfate to make 6-2.4-4.0-0.6S, Folian and NZN which are registered products from Allied. Zinc as zinc chelate was applied with one-half of the potassium polyphosphate treatments.

Table 1. Leaf burn, root rot incidence at 2 times and yield of G.N. 59 variety field beans.

Treatment	Leaf Burn ⁴	Root Rot ⁵	Root Rot ⁶	Yield cwt/a
Check	1.6 a ⁷	1.85 ns	2.50 ns	2210 a ⁸
Polyphosphate ¹ 1 time	1.9 ab	1.90	2.60	1830 abcd
Polyphosphate 2 times	2.5 ab	1.62	2.36	2130 abc
Polyphosphate 3 times	6.3 c	2.08	2.52	1870 abcd
Polyphosphate + zinc 1 time	6.0 c	1.60	2.52	1690 d
Polyphosphate + zinc 2 times	5.9 c	2.00	2.38	1870 bcd
Polyphosphate + zinc 3 times	6.6 c	1.98	2.82	2020 abcd
Folian ² 10 gal/a 1 time	2.8 ab	1.86	2.46	1980 abcd
Folian 10 gal/a 2 times	3.0 b	2.24	2.56	2040 abcd
Folian 20 gal/a 2 times	5.6 c	1.66	2.36	1770 cd
NZN ³ 1 time	1.8 ab	2.02	2.56	2200 ab
NZN 2 times	2.9 b	1.74	2.50	2040 abcd

1. Polyphosphate + urea + potassium sulfate (6.0-2.4-4.0-0.6S)
2. Folian registered by Allied Chemical
3. NZN registered by Allied Chemical
4. Leaf burn rated 1 to 10 8/23/77 readings
5. Root rot readings 1 to 5 7/26/77 readings
6. Root rot readings 1 to 5 8/23/77 readings
7. Means in the same column sharing the same letter do not differ significantly at the 1% level of probability.
8. Means in the same column sharing the same letter do not differ significantly at the 5% level of probability.

The first spray was applied when pods were beginning to fill. Weather conditions were what is considered optimum, early in the morning or when the sky was overcast, wind calm, temperatures at 60-70 F. and humidity above 50%.

FOLIAR FERTILIZER ON POTATOES AND WINTER WHEAT

Louis Daigger

The objective of these studies was to determine if fertilizer used as a foliar spray will increase yields of potatoes and winter wheat. NZN, a registered product from Allied was applied at 3 rates and two times on potatoes. NZN and potassium polyphosphate mixed with urea and potassium sulfate to make 6-2.4-4.0-0.6S was applied to winter wheat two times. Zinc as zinc chelate was applied with one-half of the potassium polyphosphate treatments. Tween 80 was added to the potassium polyphosphate and applied at 20 gallons per acre.

Table 1. Total yield, yield of No. 1's, B's and C's from NZN applied on potatoes.

TREATMENT	Total Yield cwt/a	Yield No. 1's cwt/a	Yield B's cwt/a	Yield C's cwt/a
Check	184ns	140ns	24ns	8ns
1 gal NZN 1 application	224	166	35	6
1 gal NZN 2 applications	199	148	35	6
½ gal NZN 1 application	179	135	29	10
½ gal NZN 2 applications	186	141	27	6
2 gal NZN 1 application	168	117	32	6
2 gal NZN 2 applications	177	118	35	8

First spray applied when potatoes were starting to set tubers and the second 14 days later. All applications made when the sky was overcast and temperatures below 65 F. No leaf burn was evident.

Table 2. Yield and protein of irrigated winter wheat from NZN and potassium polyphosphate, and potassium polyphosphate plus zinc chelate.

TREATMENT	Yield bu/a	Protein %
Check	51.9 ab*	10.96 bcd*
NZN applied 1 time	46.8 bc	11.12 bcd
NZN applied 2 times	41.3 c	11.96 a
Potassium polyphosphate 1 time	50.9 ab	10.82 cd
Potassium polyphosphate 2 times	51.1 ab	11.66 ab
Potassium polyphosphate plus zinc applied 1 time	47.6 abc	10.46 d
Potassium polyphosphate plus zinc applied 2 times	50.0 a	11.25 abc

*Means in same column followed by the same letter are not significant at the 5% level.

The first spray was applied when the head was beginning to emerge from the boot and the second 8 days later. Leaf burn was in evidence 6 days after the first application.

Project: Nitrogen Losses from Sprinkler Applied Nitrogen Fertilizer

Personnel: Gary W. Hergert, UN-North Platte Station

Goal: Quantify nitrogen leaching losses from sprinkler-applied urea-ammonium nitrate (UAN)

Procedure: Ceramic candle extraction systems were installed under 16 plots at the UN-Sandhills Agricultural Laboratory in 1976. Treatments were two N sources (UAN and $\text{Ca}(\text{NO}_3)_2$) and two irrigation levels based on actual crop water use (85% and 130% of evapotranspiration) replicated four times. The nitrogen rate was uniform for all plots 200 kg N/hectare.

Grain Yields: No significant effect of nitrogen source or irrigation level was shown in 1976 or 1977 (Table 1). The lack of treatment effect for the water variable is encouraging because it indicates that optimum yields may be obtained with somewhat limited water applications.

Leaching Loss of Nitrogen: Concentration ranges of nitrate-nitrogen in extractor samples of soil water are shown in Figures 1 and 2. There was no relationship between nitrate-nitrogen concentration and leaching amount or between nitrate concentration and irrigation treatment. In general, nitrate-nitrogen concentration remained constant during the season or increased with time in 1976. No concentration increases in nitrate N were shown following a sprinkler application of UAN.

In 1977 nitrate concentrations started off very high then declined. During the season concentrations remained at a constant level or increased slightly.

An average nitrate-nitrogen concentration for leachate from each plot can be calculated by determining the total nitrate-nitrogen loss during the season and dividing by the total amount of leachate collected. These data show that all of the nitrate concentrations in the leachate samples were quite high (Table 2). There was definite nitrate enrichment of deep percolating soil water due either to application of N fertilizer or residual soil nitrate. Although these concentrations are high it is important to remember that the total amount of nitrogen per hectare moved below the root zone is the main concentration. A small amount of high nitrate content leachate will still have little effect on ground water quality.

The extractor data show the importance of good nitrogen fertilizer and irrigation practices. Control of irrigation during the growing season is important to reduce losses of N. Losses occur even if the N is applied several times during the growing season if water applications exceed crop water use and soil water holding capacity (Table 3, 1976 data).

The 1977 data point out the other equally important aspect of management on sandy soils. In 1976 the low water treatments lost only 26 kg/ha of $\text{NO}_3\text{-N}$ (Table 3). For both water treatments in 1977 about 85 kg/ha $\text{NO}_3\text{-N}$ was lost by June 20 before full irrigation began. Why such large losses when good irrigation management has been practiced both years for

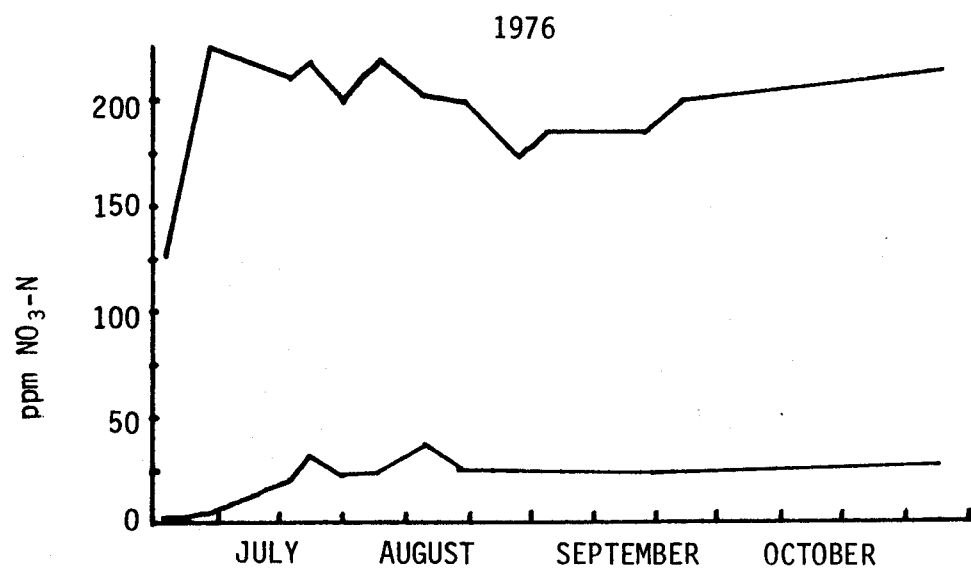


Figure 1. Nitrate-nitrogen concentrations in extractor samples of soil water, 1976.

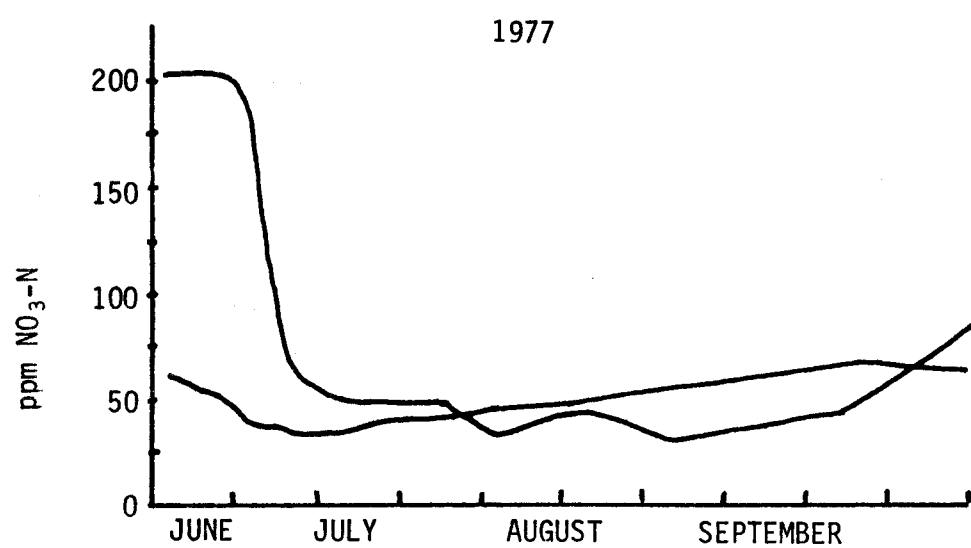


Figure 2. Nitrate-nitrogen concentrations in extractor samples of soil water, 1977.

the low water plots? Precipitation during the winter and early spring of 1977 was sufficient to fill the soil water storing capacity and leaching resulted. The 200 kg/ha N rate was more than the crop needed. Nitrogen applications must be closely matched to crop uptake and yield potential to reduce nitrate carryover.

Leaching losses of nitrogen from sandy soils can be minimized. The keys to nitrogen management are the amount and timing of irrigation water and the amount of nitrogen applied. Irrigation scheduling can help provide information for better water control. Good water control does reduce N leaching during the growing season. Knowing the yield potential of corn for a given location then matching nitrogen rates to produce the yield should help reduce carryover of nitrate-nitrogen. Research is continuing to determine proper nitrogen rates for optimum production on sandy soils in Nebraska.

Table 1. Grain yields of corn

	Irrigation			
	0.85 ET		1.30 ET	
Fertilizer	1976	1977	1976	1977
	-----kilograms per hectare-----			
UAN	7878	9126	7288	9182
CA(NO ₃) ₂	<u>7928</u>	<u>8906</u>	<u>7991</u>	<u>9634</u>
Average	7903	9016	7640	9408

Table 2. Average NO₃-N concentration in extracted soil water

Irrigation	1976	1977
	-----ppm-----	
0.85 ET	72.0	76.9
1.30 ET	106.7	69.7

Table 3. Average NO₃-N and water losses for the irrigation treatments

Irrigation	1976	1977	1976	1977
	---kg/ha leached---		-cm of water leached-	
0.85 ET	26	101	3.6	13.2
1.30 ET	186	123	19.1	18.2

Project: Lime requirement for acid sandy soils

Personnel: R. C. Sorensen and E. A. Spaugh

Lime requirements of acid, sandy soils in north and northeastern Nebraska have been determined by the Woodruff procedure. However, efforts at standardation of soil test methods among laboratories have led to the recommendation of the Shoemaker, McLean, and Pratt method (SMP) as the standard method for lime requirement. The purpose of this series of experiments was to compare several methods for determining the lime requirement with indicators derived from plant growth experiments and laboratory procedures.

Three soil testing methods for lime requirement were used. These were the Woodruff procedure, the SMP procedure, and the Adams-Evans procedure. The amount of lime needed to raise the soil to pH 6.5 upon incubation was also used. Alfalfa plants were grown in the greenhouse with different rates of lime to get two additional measures of lime requirement. One was the rate to give maximum plant weights and the other was the rate to give a soil pH value of 6.5 after the growth of plants.

Estimates of the lime requirements are shown in Table 1. The Woodruff and Adams-Evans methods appear to give similar values, whereas the SMP procedure gives values which are much lower. The values obtained from soil incubation were comparable to these obtained by the Woodruff or Adams-Evans procedures although significant departures are evident for several soils. The incubation procedure is probably the most reliable of these used.

Plant growth estimates of lime requirement were much greater than estimates derived from soil analysis. Further, there was little relationship between any of the lime requirement methods and either the rate of lime for maximum plant weight or the rate of lime to raise the soil pH to 6.5 after growth of alfalfa.

Measures of plant response to lime were plant weight, N content, and Mn content. Data collected for the 25 soils is shown in Table 2. It is evident that alfalfa growth was increased on most of the soils by the addition of lime. Very little difference in plant N content was observed as a result of liming. The plant Mn content was decreased markedly by even small amounts of lime. The greatest decrease in Mn content occurred with the first increment of added lime.

The visual effects of the lime on the growth of the alfalfa were interesting. No symptoms at all appeared on plants grown on most of the soils even though growth was improved by liming. On a few soils, the plants to which little or no lime was applied showed symptoms which were judged to be N deficiency symptoms. However, the N levels in these plants were about equal to that in plants grown on the same soils to which lime had been applied. No identifiable symptoms of Mn toxicity were observed. Since the soils were amply fertilized with phosphorus, no deficiencies of P were expected and none were found. These observations make identification of the primary deleterious effect of acid soils on the growth of alfalfa extremely difficult.

An additional series of soils has been collected to study this problem with the growth of corn. Experimentation is not yet complete.

Table 1. Lime requirement values determined by several means for 25 very sandy soils.

Soil No.	Soil pH	Woodruff (g/pot)	SMP (g/pot)	Adams-Evans (g/pot)	Incubation (g/pot)	Plant ¹ / weight (g/pot)	Plant ² / growth (g/pot)
1	5.7	1.2	0.0	1.5	1.6	3.6	4.0
2	5.7	1.2	0.0	2.0	0.5	4.1	4.0
3	5.7	1.2	0.0	2.0	0.4	- ^{3/}	2.7
4	6.6	0.0	0.0	0.0	0.2	2.6	2.7
5	5.3	3.0	0.9	2.0	2.5	3.6	4.0
6	5.2	4.8	0.4	4.5	0.3	3.7	6.7
7	6.8	0.0	0.0	0.0	0.3	-	1.3
8	4.8	3.0	1.4	2.0	2.6	-	4.0
9	5.7	1.8	0.0	1.0	0.5	3.6	4.0
10	6.2	1.2	0.0	0.0	0.0	-	2.7
11	5.9	1.2	0.0	0.5	1.0	3.7	4.0
12	5.2	3.6	1.9	3.0	3.3	4.5	5.3
13	5.4	3.6	1.9	3.0	3.5	-	5.3
14	5.5	1.2	0.0	2.0	0.8	3.5	4.0
15	5.3	1.8	0.0	2.0	0.9	4.6	4.0
16	5.2	2.4	0.2	2.0	3.3	4.4	5.3
17	4.8	2.4	0.2	2.0	2.5	3.5	5.3
18	5.1	2.4	0.0	3.0	1.6	9.0	4.0
19	5.1	2.4	0.0	3.0	2.5	5.3	5.3
20	5.1	3.0	1.4	3.0	2.5	6.8	5.3
21	5.8	1.8	0.0	2.0	1.6	-	5.3
22	4.7	3.6	2.4	4.0	3.8	4.1	5.3
23	5.5	2.4	0.2	2.0	3.3	3.3	5.3
24	5.1	3.6	1.9	3.0	4.0	8.7	6.7
25	5.1	2.4	0.4	3.0	2.3	-	4.0

¹/ Rate for maximum plant weight.²/ Rate to give soil pH at least 6.5 after growth.³/ Unable to get maximum because of curve shape.

Table 2. Plant weight, N content, and Mn content as affected by liming. Value for limed treatment in average of three values for rates of 4.0, 5.3, and 6.7 g CaCO₃ per pot.

Soil No.	Soil pH	Plant weight		Plant N content		Plant Mn content	
		No Lime	Lime	No Lime	Lime	No Lime	Lime
		g.	g.	g.	g.	g.	g.
1	5.7	2.37	3.18	2.16	2.32	186.0	45.0
2	5.7	3.04	3.69	2.35	1.79	161.0	40.0
3	5.7	1.72	2.40	2.25	2.21	117.0	32.0
4	6.6	3.74	4.22	2.42	2.48	70.0	49.0
5	5.3	1.83	4.02	2.72	2.15	73.0	45.0
6	5.2	2.85	5.57	3.18	3.62	150.0	65.0
7	6.8	2.18	2.10	2.32	2.08	110.0	31.0
8	4.8	- ^{1/}	-	-	-	-	-
9	5.7	4.05	5.13	2.38	1.94	100.0	40.0
10	6.2	3.47	3.15	2.01	2.16	100.0	40.0
11	5.9	5.30	6.43	2.10	1.97	117.0	41.0
12	5.2	2.50	4.51	2.48	2.67	121.0	42.0
13	5.4	5.90	7.70	2.28	2.03	89.0	34.0
14	5.5	1.81	2.64	2.28	1.97	191.0	33.0
15	5.3	1.75	2.56	2.19	2.04	197.0	55.0
16	5.2	2.49	4.47	2.40	2.05	169.0	60.0
17	4.8	1.81	3.22	2.34	2.16	200.0	43.0
18	5.1	2.12	3.05	2.33	2.16	163.0	61.0
19	5.1	2.64	4.08	2.84	2.38	162.0	51.0
20	5.1	3.60	4.40	2.28	2.78	131.0	37.0
21	5.8	7.39	7.20	2.90	2.54	75.0	33.0
22	4.7	0.31	5.91	2.55	2.42	-	33.0
23	5.5	4.09	4.85	2.54	2.58	98.0	35.0
24	5.1	4.81	7.12	1.87	2.05	152.0	39.0
25	5.1	-	-	-	-	126.0	43.0

^{1/} Plant growth confounded by atrazine damage.

Optimum Economic Use of Fertilizers Through
Effective Soil Testing^{1/}

R.A. Olson, L.A. Daigger, K.D. Frank, P.H. Grabouski and G.W. Rehm

Within the short span of 25 years commercial fertilizer has grown from insignificance to the major production cost item to the Nebraska farmer among requisites purchased in support of crop production. Certainly the vast majority will agree that it would be virtually impossible to stay in the farming business today without the fertilizer input.

It is characteristic of soils to vary in chemical properties, including nutrient supplying capacity, from one place to the next by reason of different soil forming materials and varied environments during the period of soil development. Differential management of the soil from farm to farm and field to field since cultivation began has contributed further variability to soil fertility. Researchers in soil fertility have devised soil testing procedures that afforded indexes of plant nutrient availability in the soil and have calibrated these to likely yield responses to applied nutrients through countless fertilizer experiments in the field. As a consequence, reliable soil testing has become the most viable means of prescribing appropriate kind and amounts of fertilizers for most economic crop response on any given field.

Although fertilizers are here to stay and soil testing is a must for arriving at appropriate treatments, considerable confusion on the issue has been reported to us by farmers due to varied recommendations afforded by different soil testing laboratories for the same soil. It was for the purposes of further checking the reliability of the University's soil test calibrations and for bringing about greater uniformity of recommendations that the study reported here was conducted. In no sense was the objective that of increasing the Extension Service's approximate 20 percent of the state-wide soil testing business.

^{1/}This article is a brief summary of an Agronomy Department Report by the soil-fertility staff of UNL covering experiments conducted at the South Central Station, the North Platte Station, the Northeast Station, the High Plains Lab and the Mead Field Lab during 1973-77.

During the first year of the five-year period 1973-77 a soil sample was collected from the experimental area, was split into equal parts and sent to five laboratories doing most of the soil testing business in Nebraska. The samples were sent under farmer names in all cases such that every laboratory, including the University's, was making its conventional recommendation for a farmer's production field, and no laboratory knew that its services were being used for this purpose. After the first year samples were taken on the respective plots assigned to each laboratory, each sample being somewhat different in nutrient status due to differentials in treatments that had been recommended.

Tables 1-6 report results for experimental locations of at least four years' duration. Note that no significant differences in yield were obtained at any of the sites producing corn despite wide variations in the kinds and amounts of nutrients recommended by the different services. In every case during the four or five years involved, the minimum fertilizer treatment was most economically advantageous. Especially striking is the fact that only 40 lbs N/A was adequate for optimum yield at the South Central Station site in 1977 after the previous years of much heavier N treatment and that no N at all was needed on the Northeast Station in 1977 because of the high residual N level. It is apparent that the secondary and micronutrients recommended by some of the soil testing services were having no impact on yields at these experimental sites.

The experiments on winter wheat at the High Plains Station (Tables 5 and 6) provide only two years of yield since the land here is summer fallowed in alternate years. Yield effects in this case did favor the slightly higher fertilizer costs associated with additional P application although not the much higher costs of the A & B services.

Other experiments have been conducted for single years on potatoes and sugar beets showing greatest economic return with the minimal fertilizer recommendations. These results can be observed in Agronomy Department Report No. 18 of 1976.

In summary, these experiments make clear that additional kinds and amounts of fertilizers will not benefit yields if the amounts of those elements are already adequate in the soil. By the same token, no farmer can afford to be without nutrients needed for optimum yield in today's competitive agriculture. It is mandatory that the integrity of soil testing be preserved because of its economic importance to the farmer. Less obvious are the facts of resource conservation and the prevention of environmental pollution by nutrients.

Table 1. Soil Test Laboratory Comparison, Mead Field Laboratory, Irrigated
Corn (170 bu/A yield goal), 1973-77.

Nutrient or year	Laboratory				
	A	B	C	D	E (UNL)
Recommended Nutrients lbs/A, 1977					
N	215	190	210	180	190
P ₂ O ₅	30	50	80	120	--
K ₂ O	60	80	60	--	--
MgO	--	15	--	--	--
S	--	30	30	--	--
Zn	--	2	10	--	--
Mn	--	1	--	--	--
Cu	--	--	1	--	--
B	--	--	$\frac{1}{2}$	1	--
Fertilizer Costs, \$/A, 1973-77					
1973	42	32	41	25	17
1974	96	69	90	57	39
1975	97	77	90	52	52
1976	51	32	61	35	32
1977	38	55	68	49	23
Total	\$324	\$265	\$350	\$218	\$163
Yield of Corn, bu/A, 1973-77					
1973	152	148	153	148	160 n.s.*
1974	139	131	131	137	133 n.s.
1975	162	157	153	160	158 n.s.
1976	143	143	129	143	137 n.s.
1977	148	143	136	142	145 n.s.
Total Bu	744	722	702	730	733

* Nonsignificant differences

Table 2. Soil Test Laboratory Comparison, South Central Station,
Irrigated Corn (200 bu/A yield goal), 1974-77.

Nutrient or year	Laboratory				
	A	B	C	D	E (UNL)
Recommended Nutrients, lbs/A, 1977					
N	215	190	260	190	40
P ₂ O ₅	70	90	80	120	--
K ₂ O	--	20	--	--	--
MgO	--	30	--	--	--
S	22	45	40	--	--
Zn	--	--	8	--	--
Cu	--	--	1	--	--
B	--	$\frac{1}{2}$	$\frac{1}{2}$	--	--
Fertilizer Costs, \$/A, 1974-77					
1974	82	72	79	46	38
1975	96	70	93	43	55
1976	71	50	66	26	36
1977	46	65	68	49	5
Total	\$295	\$257	\$306	\$164	\$134
Yield of Corn, bu/A, 1974-77					
1974	186	189	187	189	184 n.s.*
1975	203	206	196	201	194 n.s.
1976	188	186	186	196	199 n.s.
1977	154	155	156	154	166 n.s.
Total Bu	731	736	725	740	743

* Nonsignificant differences

Table 3. Soil Test Laboratory Comparison, North Platte Station,
Irrigated Corn (170 bu/A yield goal), 1974-77

Nutrient or year	Laboratory				
	A	B	C	D	E (UNL)
Recommended Nutrients, lbs/A, 1977					
N	185	195	240	180	180
P ₂ O ₅	---	60	---	---	---
K ₂ O	---	40	---	---	---
MgO	---	35	---	---	---
S	---	20	40	---	---
Zn	---	---	10	---	---
Cu	---	---	1	---	---
B	---	---	$\frac{1}{2}$	---	---
Fertilizer Costs, \$/A, 1974-77					
1974	56	68	82	39	29
1975	83	47	72	46	34
1976	58	68	75	39	29
1977	<u>23</u>	<u>56</u>	<u>50</u>	<u>22</u>	<u>22</u>
Total	\$220	\$239	\$279	\$146	\$114
Corn Yield, bu/A, 1974-77					
1974	167	168	155	155	159 n.s.*
1975	216	208	210	217	222 n.s.
1976	148	130	133	128	132 n.s.
1977	<u>173</u>	<u>180</u>	<u>177</u>	<u>176</u>	<u>172</u> n.s.
Total Bu	704	686	675	676	685

* Nonsignificant differences

Table 4. Soil Test Laboratory Comparison, Northeast Station,
Non irrigated Corn (90 bu/A yield goal), 1974-77.

Nutrient or Year	Laboratory				
	A	B	C	D	E (UNL)
Recommended Nutrients, lbs/A, 1977					
N	65	75	40	110	--
P ₂ O ₅	--	20	--	39	--
K ₂ O	40	15	--	25	--
S	20	20	20	--	--
Zn	2	2	3	--	2
B	--	--	1	--	--
Fertilizer Costs, \$/A, 1974-77					
1974	38	28	49	29	12
1975	16	18	20	20	16
1976	40	29	49	12	11
1977	17	21	14	24	2
Total	\$111	\$96	\$132	\$85	\$41
Corn Yield, bu/A, 1974-77					
1974	----- No yield due to drouth -----				
1975	59	60	56	52	59 n.s.*
1976	9	11	14	10	15 n.s.
1977	144	145	149	144	142 n.s.
Total Bu	212	216	219	206	216

* Nonsignificant differences

Table 5. Soil Test Laboratory Comparison, High Plains Laboratory #1
 Summer fallowed winter wheat (50 bu/A yield goal), 1974-77.

Nutrient or Year	Laboratory				
	A	B	C	D	E (UNL)
Recommended Nutrients, lbs/A, 1977					
N	40	65	60	40	40
P ₂ O ₅	65	50	40	40	60
K ₂ O	10	--	--	--	--
MgO	10	15	--	--	--
S	10	27	--	--	--
Zn	4	3	--	--	--
Mn	2	3	--	--	--
Cu	--	1	--	--	--
Fertilizer Costs, \$/A, 1974-76					
1974	32	33	20	16	28
1976	<u>31</u>	<u>41</u>	<u>16</u>	<u>14</u>	<u>18</u>
Total	\$63	\$74	\$36	\$30	\$46
Yield of Wheat, bu/A, 1975-77					
1975	41	41	42	40	47
1977	<u>29</u>	<u>33</u>	<u>35</u>	<u>34</u>	<u>34</u>
Total Bu	70	74	77	74	81

Table 6. Soil Test Laboratory Comparison, High Plains Laboratory #2
 Summer fallowed winter wheat (60 bu/A yield goal), 1974-77

Nutrient or Year	Laboratory				
	A	B	C	D	E (UNL)
Recommended Nutrients, lbs/A, 1977					
N	40	65	50	30	40
P ₂ O ₅	20	60	---	---	40
K ₂ O	---	---	---	---	---
MgO	10	---	---	---	---
S	10	27	---	---	---
Zn	3	2	---	---	---
Mn	---	2½	---	---	---
Fertilizer Costs \$/A, 1974-76					
1974	23	30	18	10	16
1976	19	30	6	4	14
Total	\$42	\$60	\$24	\$14	\$30
Yield of Wheat, bu/A, 1975-77					
1975	68	64	57	60	68
1977	49	50	48	51	52
Total Bu	117	114	105	111	120

Fertilizer Needs Under Conditions of High P and K Accumulation in Soils

R.A. Olson, G.W. Rehm and L.S. Daigger

A. Objective

It is the objective of this study to investigate the depletion or accumulation of plant available P and K in soils with intensive crop production and varied fertilizer application rate.

B./ General

Conditions were not promising at the beginning of the 1977 growing season following three years of drouth with essentially no subsoil moisture storage. Timely rains and above-normal total rainfall for the year in all but southeastern Nebraska, however, modified the earlier situation. Good corn yields at the Mead site in southeastern Nebraska resulted from timely irrigation without which there would have been little or no grain yield. Remarkably good yields of corn were obtained at the Northeast Station without irrigation. Only at the High Plains Station did weather have some adverse effect, there on wheat, due to dry surface soil at planting and accompanying winter damage to stands.

C. Experimental Results

Table 1 summarizes the 1977 yield response of irrigated corn to the varied P and K treatments on Sharpsburg sil and the five-year average results to date. There was a barely significant difference of treatment means at the five percent level in 1977, for which there is no plausible explanation. The differences would appear to be more the result of variability in corn borer damage than of treatment effect. Apparently there is still minimal, certainly not economic, response to applied P on this Sharpsburg soil of medium soil test P level and none to applied K. The five-year summary gives similar indication with further suggestion that the higher K level may have been deleterious.

The soil test data of Table 1 demonstrate that available soil P and K levels have not been depleted measurably over the five-year period without P and K treatment even though yields have averaged better than 160 bu/a. At the same time it is clear that application of rates that provide a 10 lb P/a annual equivalent are perceptibly increasing soil P tests by the Bray and Kurtz #1 procedure and that 30 lbs P/a annually has more than doubled the test level in five years. Similarly, exchangeable soil K levels have not declined perceptibly without added K, but added K has not noticeably changed the existing high levels in this soil.

Yield response of non-irrigated corn grown on Moody-Nora sil to the P and K treatments is presented in Table 2. There was no significant response to either P or K treatment in 1977. In prior years there has been some response to applied P on this soil of medium-low soil test level such that economic benefit would have resulted from the 10 lb P application over the four-year period to date. There has been no K response on this moderately high K soil, and rather a trend toward detriment from the higher rate as on the Sharpsburg.

Soil test P on the control plots has fluctuated through the 1973-77 period without certain evidence of decline despite good average yields in excess of 100 bu/a.

There is no question, however, that 10 lbs P/a/year has increased the Bray & Kurtz #1 soil test level in five years bringing it up to the medium category and that 30 lbs has tripled the level. Soil exchangeable K has not changed noticeably without treatment, but does show evidence of a small increase with K treatment on this moderately high K level soil.

The trial with winter wheat reported in Table 3 has been in operation since 1974, but to date reports only two crops since the land is summer fallowed in alternate years. Yields in 1977 were excellent by any standards for winter wheat but are quite erratic due to nonuniform stand caused by dry soil at planting and the severe winter. It is doubtful that any real yield effects were registered in the loess-derived Keith sil, but there is a reasonably strong indication of P response up to the 20 lb level on the Rosebud sil with no effect of added K.

D. | Summary

Results from studies on the four Nebraska soils to date indicate that responses to applied P and K are less than quite generally prognosticated by fertilizer sales programs. Furthermore, there is hardly perceptible decline in soil P and K levels as measured by conventional laboratory technique despite high grain yield removals. In fact, it is documented that the low rate of 10 lbs P/a has distinctly increased the available P level of the soil in the five-year period. There is no evidence from these experiments that added P or K will afford any yield benefit if the soil possesses a medium to high soil test level.

Table 1. Corn response to a long-term P and K soil buildup/depletion study on irrigated Sharpsburg silt, Mead Field Lab, Nebraska, 1973-1977.

Treatment*		Application Schedule	Grain Yield		Soil Test P			Soil Exch K		
P	K		1977	5 yr avg	1973	1975	1977	1973	1975	1977
			bu/a		ppm P			ppm K		
0	0	Control	160	160	15	12	14	320	350	320
10	0	Every year @	159	161	15	15	18	311	301	347
20	0	Every year @	169	164	16	16	24	310	323	337
30	0	Every year @	164	166	19	27	34	300	286	334
20	0	Every other year @	155	157	16	20	30	300	321	391
30	0	Every 3rd year	160	162	25	12	21	288	297	360
60	0	Every other year @	156	157	22	41	51	283	307	402
60	0	Every 6th year	155	155	30	14	19	288	285	377
20	25	Every year @	171	168	16	16	30	296	316	389
20	50	Every year @	164	154	14	20	24	296	304	326
10	25	Every year--row @	154	152	11	14	18	268	285	420
LSD ₍₀₅₎			16							

* Uniform N application made to all plots for optimum yield; P and K treatments broadcast except for indicated row application; grain yield on 15.5% moisture basis. An @ indicates application in 1977.

Table 2. Corn response to a long-term P and K soil buildup/depletion study on Moody Nora sil, Northeast Station, Nebraska, 1973-77.

Treatment*		Application Schedule	Grain Yield		Soil Test P			Soil Exch K		
P	K		1977	4 yr avg**	1973	1975	1977	1973	1975	1977
			bu/a		ppm P			ppm K		
0	0	-	152	101	9.5	11.3	7.3	223	183	186
10	0	Every year @	165	109	9.3	10.5	12.9	220	179	179
20	0	Every year @	160	110	11.5	12.3	16.0	228	177	187
30	0	Every year @	159	107	22.3	20.0	26.8	234	175	198
20	0	Every other year @	160	103	9.3	10.5	12.0	218	179	196
30	0	Every 3rd year	158	106	17.0	8.8	12.1	224	178	190
60	0	Every other year @	158	105	11.3	13.0	22.3	213	173	202
60	0	Every 6th year	158	107	10.5	11.8	10.5	202	166	189
20	25	Every year @	163	108	9.5	11.5	15.7	220	181	204
20	50	Every year @	158	104	11.3	13.5	19.2	238	210	218
LSD ₍₀₅₎			n.s.							

* Uniform N application made to all plots for optimum yield; P and K treatments broadcast; grain yield on 15.5% moisture basis. An @ indicates application in 1977.

**No yield in 1974 due to drouth.

Table 3. Response of winter wheat to a long term P and K soil buildup/depletion study on the High Plains Ag Lab, Nebraska, 1975-1977.

Treatment*		Application Schedule	Grain Yield**				Soil Test P	Soil Exch K
P	K		Keith sil		Rosebud fsal		1977	1977
			1977	2 yr avg	1977	2 yr avg		
----- bu/a -----								
0	0	Control	62.8	57.3	48.6	44.7	Not Yet	
10	0	Every Year @	70.6	59.4	51.8	46.8	Available	
20	0	Every Year @	59.7	53.1	55.4	49.9		
30	0	Every year @	70.0	62.3	56.1	48.3		
20	0	Every other year @	69.8	60.9	52.4	44.6		
30	0	Every 3rd year	70.0	60.1	49.5	41.7		
60	0	Every other year @	66.2	60.3	55.2	47.8		
60	0	Every 6th year	67.1	59.2	60.0	50.0		
20	25	Every year @	70.6	60.6	55.3	47.5		
20	50	Every year @	74.0	62.7	51.1	43.7		
LSD (05)			9.1		8.8			

* Uniform N application made to all plots for optimum yield; P and K treatments broadcast; grain yield on 14% moisture basis. An @ indicates application in 1977.

**Grain produced only in alternate years with land summer fallowed during the interim.

Project: Northeast Nebraska Soil Productivity Studies

Personnel: E. A. Spaugh and R. C. Sorensen

- I. Increasing acreages of sandy soils in northeast Nebraska are being brought into cultivation and irrigation. Little is known about the long-range fertility and productivity of these soils. Multiple experiments are being conducted to determine general and specific problems likely to be encountered in intensive field crop production on these soils and pertinent solutions. Bulk soil samples were collected from seventeen fields in Holt, Antelope, and Pierce counties. Maximum, minimum and average soil test values were:

	<u>pH</u>	<u>% O.M.</u>	<u>ppmP</u>	<u>ppmK</u>	<u>ppmCa</u>	<u>ppmMg</u>	<u>ppmNa</u>	<u>% sand</u>
Max.	7.1	2.51	124	238	5808	270	25	90
Min.	5.1	0.82	1	70	386	38	11	72
Avg.	5.9	1.37	79	129	1236	99	16	85

II. Phosphorus Leaching

Phosphorus has long been characterized as an immobile nutrient and farmers have been told that phosphorus does not move in the soil. Results of this laboratory experiment and of other lab and field experiments show that phosphorus does move in soil, especially in sandy soils. Plastic columns were carefully filled to a height of forty cm with soils collected from northeast Nebraska (see part I). Columns were wetted and allowed to drain overnight. Fifty additional grams of each soil were mixed with .25g $\text{Ca}(\text{H}_2\text{PO}_4)_2$ and added to the top of the appropriate soil column. Sixty mls of distilled water were added to each column daily for 10 days (total 600 mls or 16" water). Columns were then separated at depths of 2, 4, 6, 8, 12, 16, 20, 24, 30, 36 and 42 cm and analyzed according to NCR-13 procedures.

Of the seventeen soils, only five showed P values less at any point of the column than original soil test, three in the top two cm, and two in the bottom 6 cms. All other soils had increased P values throughout the column. Depth of maximum P concentration differed among the soils, occurring most often in the 8 to 12 cm section.

III. Nutrient Release - Water Extraction

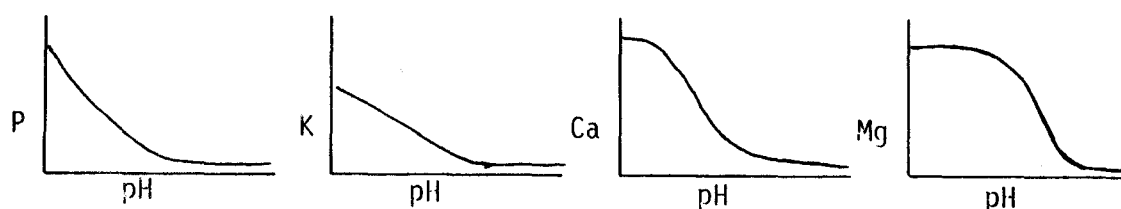
Mechanisms, timing, and amount of nutrient release from the sandy soils of northeast Nebraska are not known. In an attempt to characterize nutrient release and determine environmental effects on nutrient release, soils (see part I) were mixed with distilled water in solution:soil ratios of 1, 2, 4, 8 and 16 and were promptly shaken for 0 (swirled to mix), 5, 10, 15, and 20 minutes. Samples were then filtered and the resultant filtrate analyzed for P, K, Ca, and Mg by standard NCR-13 procedures.

P and K release were a function of water - more water released more nutrient. Ca and Mg release were dependent on solution:soil ratio in some soils (Ca in 3, Mg in 6), shaking time in other soils (Ca in 4, Mg in 8), and neither in some soils (Ca in 11, Mg in 6).

IV. Nutrient Release - Acid Extraction

Rainfall and irrigation water are often slightly acid. Dilute HCl ranging in pH from 0 to 5.1 was mixed in a solution:soil ratio of 16 with soils (see part I) and shaken for 20 minutes. Extracts were analyzed for P, K, Ca, and Mg to (a) determine the effect of pH of extracting solution on nutrient release and (b) to estimate actual amounts of nutrient possibly available for long-term release.

Nutrient release stabilized between pH 2.6 and 3.5 and differences above pH 3.5 were negligible. Below pH 3.5, K release increased linearly. Curve shapes for nutrient release - pH interaction are illustrated below.



Although actual values of nutrients released varied greatly, the ratios of the HCl extracted value/soil test value were remarkably similar for 15 of the 17 soils and may be useful in future work.

Sand fractions of the soils were separated and subjected to treatment as above up to pH 4.2. The extract values from the fractions were multiplied by the weight percent of the sand separate in the whole soil to determine how much nutrient the sand fractions contributed.

Total sand contributions of P ranged from 0 to 100%, of K from 1.6 to 2.6%, of Ca from 5 to 30%, and of Mg from 9 to 47% at pH 4.2 (chosen for illustration because highest pH used). The contribution of the sand was dependent in some cases on the amount of sand, in some cases the amount of nutrient in a unit of sand was primary, and in some cases both factors were involved.

V. Further Studies

We feel the above studies have given us a good beginning in understanding nutrient release from these sandy soils. This will be further developed with mineralogical studies, plant growth experiments, and other experiments as the project personnel determine useful.

PHEASANT REPELLENCY EXPERIMENTS

December 1, 1977

Leroy L. Peters and Kenneth D. Frank

Objective

To determine the efficacy of Mesuro[®] [3,5-Dimethyl-4-(methylthio)phenol methylcarbamate] in reducing feeding damage to newly planted corn seeds and seedling plants by pheasants.

Test Location

University of Nebraska, South Central Station Farm, Clay County, Nebraska.

Methods and Materials

Land for this experiment had been in brome-alfalfa for many years. The soil type was Hastings silt loam with a pH of 6.0 and organic matter of about 3.2 percent.

The experiments were planted with slot shoes on the Buffalo till planter. Required amounts of Mesuro[®] were placed with seed corn, placed in large paper bags, and thoroughly mixed before putting the treated seed in the planter seed boxes.

Figure 1 shows treatments and plot layout.

Efficacy of treatments was determined by counting emerged plants in each plot when the plants were approximately four inches tall. Plants from three 20-foot samples of each row distributed throughout the length of the plot were counted.

Results

Stand counts were quite variable (Table 1) both within and between treatments. As a consequence of this variability, the differences in stand count were not significant at the 5 percent level between treatments. No consistent trends were noted. Pheasant damage to corn stands over the entire farm appeared to be lower than previous years. The fact that all of the remaining 120 acres (approximately) of corn was treated with 8 ounces of 50 percent Mesuro[®] Hopper Box Treatment cannot be overlooked as a possible cause of lowered pheasant activity.

Table 2 shows that corn yields were not influenced by the Mesuro[®] treatments.

Figure 1. Experimental Layout of Experiment 63

Rep 1	4 ST	UNT = Untreated 4 HB = 4 Oz Mesuro1 50% Hopper Box Treatment Per 100 Lbs Seed 8 HB = 8 Oz Mesuro1 50% Hopper Box Treatment Per 100 Lbs Seed
	UNT	
	8 HB	
	4 HB	
2	8 HB	4 ST = 4 Oz Mesuro1 75% Seed Treatment Per 100 Lbs Seed 4 Rows Per Treatment Spaced 30 In, 600 Ft Long
	4 ST	
	UNT	
	4 HB	
3	4 ST	Corn Variety - Pioneer 3382 Planted - May 20, 1977, In Brome-Alfalfa Sod
	UNT	
	4 HB	
	8 HB	

Table 1. Plant Stand Counts, Pheasant Repellency Tests
UN-SCS, 1977

Treatment	Average Stand Count (Plants Per Acre)
Untreated	23,087
Mesuro1 50% HBT 4 Oz/100 Lbs Seed	24,777
Mesuro1 50% HBT 8 Oz/100 Lbs Seed	21,493
Mesuro1 75% ST 4 Oz/100 Lbs Seed	21,057

Table 2. Influence of Mesuro1[®] on Grain Yield of Corn Planted in Sod

Plot	TREATMENT Oz Mes % Seed Trt	GRAIN YIELD (Bu/A)	Plot	TREATMENT Oz Mes % Seed Trt	GRAIN YIELD (Bu/A)
101	4 Oz 50%	95	107	4 Oz 75%	136
102	4 Oz 50%	102	108	4 Oz 75%	97
201	4 Oz 50%	140	205	4 Oz 75%	90
202	4 Oz 50%	95	206	4 Oz 75%	116
303	4 Oz 50%	83	307	4 Oz 75%	94
304	4 Oz 50%	92	308	4 Oz 75%	102
	Total	607		Total	635
	Mean	101		Mean	106
103	8 Oz 50%	125	105	0 Oz 0%	88
104	8 Oz 50%	104	106	0 Oz 0%	136
207	8 Oz 50%	110	203	0 Oz 0%	---
208	8 Oz 50%	128	204	0 Oz 0%	117
301	8 Oz 50%	117	305	0 Oz 0%	88
302	8 Oz 50%	92	306	0 Oz 0%	86
	Total	676		Total	515
	Mean	113		Mean	103

Table 3. Analysis of Variance for the Influence of Mesuro[®] on Grain Yield

Source	Degrees of Freedom	Sum of Squares	Mean of Squares	f Value
Total	19.0	5,790.80		
Block	4.0	1,183.80	295.95	0.87
Treatment	3.0	565.20	188.40	0.55
Error	12.0	4,041.80	336.81	